NOVA SCOTIA DEPARTMENT
OF MINES AND ENERGY

OPEN FILE REPORT
90-009
INVESTIGATION OF THE CHEGOGGIN POINT, LAKE GEORGE, YARMOUTH COUNTY, SILICA AND GARNET DEPOSIT

by

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Nova Scotia Department of Mines and Energy

Canada-Nova Scotia Mineral Development Agreement

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INVESTIGATION OF THE CHEGOGGIN POINT, LAKE GEORGE, YARMOUTH COUNTY, SILICA AND GARNET DEPOSIT

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ABSTRACT

A very high grade silica and garnet occurrence at Chegoggin Point, Yarmouth County, has been previously explored and portions mined. The results of this work indicated high quality silica and garnet ore, but little was known of the reserves and extent of the deposit. This recent program conducted by the Nova Scotia Department of Mines and Energy and funded under the Canada-Nova Scotia Mineral Development Agreement included geological mapping and a geophysical survey program to help delineate and trace the silica beds. Nine diamond-drill holes were completed on targets chosen from these new data.

Geophysical means employed during this program have proven to be an unreliable means of locating the silica beds. A diamond-drill hole (CH-LG-87-6), completed north of the old DOSCO quarry at Chegoggin Point, provided valuable structural and quality information for the silica bed at this location. Other drillholes completed along strike indicated that the silica beds are not as continuous and consistent as previously thought, but that the silica is contained in separate displaced, high grade pods.

ACKNOWLEDGMENTS

Grateful acknowledgments are made to the following people: Mr. John H. Fowler of the Nova Scotia Department of Mines and Energy, whose many years of familiarity and knowledge of the Chegoggin Point-Lake George silica deposit were a welcome source of advice and ideas on how to approach this project; Cyril Cole of the Minerals Engineering Centre at Technical University of Nova Scotia who performed the many spectrographic and chemical analyses on the core samples; Mr. Brian D'Entremont of Eastern Geophysics Limited whose innovative ideas and knowledge were appreciated in attempting to find suitable geophysical means of locating the quartzite beds; the Drilling Division of the Nova Scotia Department of Mines and Energy who succeeded in providing excellent core recovery of some extremely hard rock; Mr. E. H. MacKinnon, Division Engineer of the Department of Transportation and Communications in Yarmouth for his support of the project and for providing a temporary home away from home for our drilling equipment; Kathy Mills for editorial assistance; Susan Saunders for word processing; the Nova Scotia Department of Mines and Energy cartography section for drafting assistance; and most importantly the private landowners of the project area who were most gracious in permitting access and diamond drilling on their properties. The project was funded under the Canada-Nova Scotia Mineral Development Agreement.

INTRODUCTION

High purity silica deposits have always been sought for such traditional uses as silica brick manufacture, glass making and sandblasting. In recent years many new specialty uses for silica have been found and although the overall market is not exceptionally large on a volume or dollar basis, there are some attractive niche applications. Prices for these specialized products range from 3¢ a pound for ground silica to a high of $6.00 a pound for certain fumed silicas.

The Nova Scotia Department of Mines and Energy (NSDME) had under closure 76 claims which controls the known and assumed outcropping of the previously mined high grade silica deposit at Chegoggin Point, Yarmouth County. This provided the Various Commodities Project the opportunity to conduct this recent exploration program designed to better understand the orientation and extent of this deposit and to provide additional data on the grade and potential reserves available. This recent program included geological mapping, geophysical surveying and diamond drilling.

LOCATION AND ACCESS

The property is located in Yarmouth County and the claims that were under closure range from 6.4-24 km north-northwest of the Town of Yarmouth and form an unbroken strip from Chegoggin Point northeast to Lake George. Access to the individual claims is provided by an excellent network of secondary paved and gravel roads. Highways 1 and 101 bisect the deposit just west of Sunday Lake. The silica beds outcrop at the coast and extend inland. Water depths in excess of 12 m are indicated on hydrographic charts within a few hundred metres offshore from the deposit providing excellent deep water on tidewater.

TOPOGRAPHY

The topography is generally low relief except at the coast where cliffs range up to 30 m in height. With the exception of a ridge of volcanic rocks just north of the Town of Yarmouth, the only hills consist of glacial debris mainly in the form of drumlins. Glacial till depths range from 3-6 m. A few small lakes and swampland are located above the deposit.

LAND USE

The major landuses of the study area are forestry and agriculture. Most of the forested areas are poor to very poor quality and contain numerous wetlands and peatbogs. The majority of the agricultural activities are dairy and mixed farming. Areas surrounding some of the larger lakes are used for recreation and there is a prescribed watershed around Lake George. There are no heavily populated urban areas, but mainly isolated areas of strip development along roadways and at some intersections. A few small gravel pits are located in the area accessing material from the scattered drumlins.

REGIONAL GEOLOGY

The bedrock consists of metamorphic rocks derived from both igneous and sedimentary material ranging in age from early Ordovician to early Silurian (Fig. 1). The rocks contained in the study area are assigned to the White Rock Formation (Taylor, 1967) and are preserved within a syncline, the axis of which strikes 20° northeast through Yarmouth Sound. The White Rock Formation overlies the Meguma Group which outcrops 10 km to the northwest at Cranberry Point and 4 km to the southeast at Chebogue Point. The rocks occurring between these two localities and also inland to Lake George measure 4 km in thickness and are composed of the metamorphic derivatives of 60% volcanic and 40% siliclastic rocks.

Within the siliclastic section a very high percentage silica orthoquartzite is exposed along the coast which was previously quarried at Chegoggin Point and has been intersected and sampled with diamond-drill holes at different intervals towards the western shore of Lake George 16 km to the northeast. The quartzite is lenticular and randomly pinches and swells throughout with many silty partings in places. Several vertical faults subparallel the axial trace of the regional syncline (Lane, 1979) and as a result the quartzite beds have been displaced and even repeated along

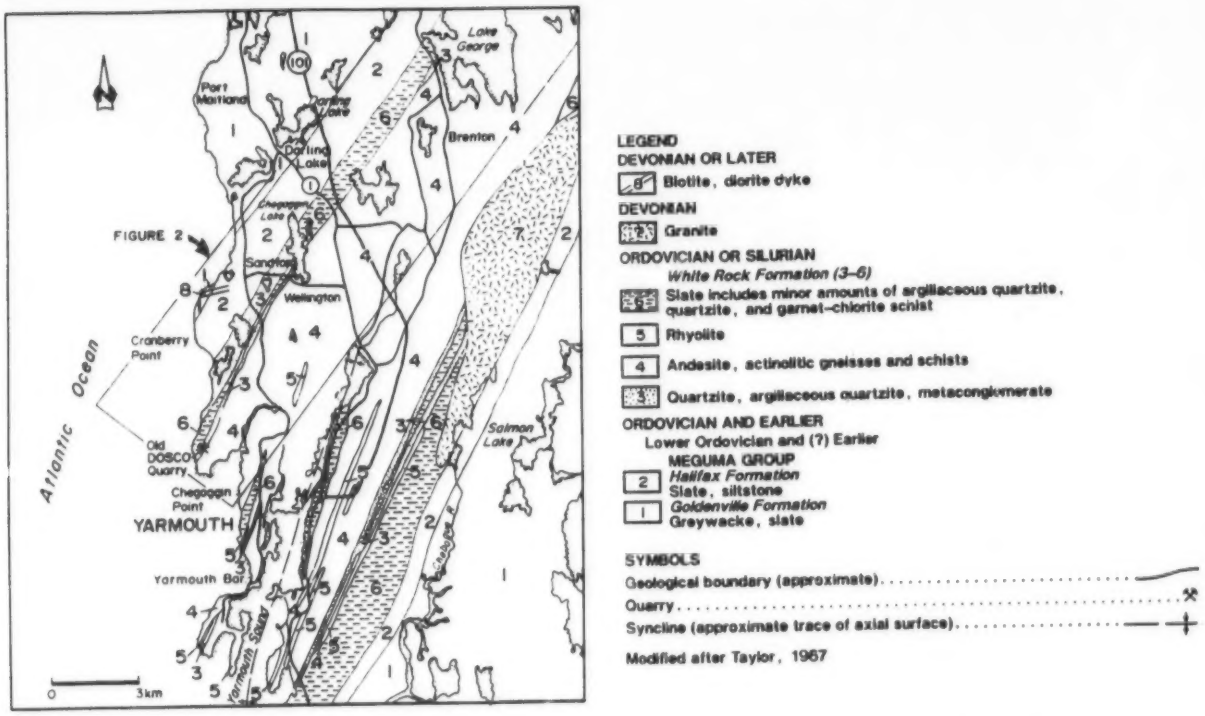

Figure 1. Geological map for the Chegoggin Point, Lake George, Yarmouth County area outlining Figure 2

the coast at Chegoggin Point. The simplified section found at Chegoggin Point has massive volcanics towards the synclinal axial end of the section and as one moves westward metasedimentary rocks (siliclastic rocks) such as silty slates (pelitic schists) and orthoquartzites with a few thin sills and dykes of greenstone occur (Sarkar, 1978). The section along the coast appears to be repeated with two similar orthoquartzite beds separated by faulting (slickensides, rock powder and badly broken rock). Included in the siliclastic section are layers of cordierite-garnet metamorphism with one 4 m thick bed of garnet biotite schist containing 40-50% almandine garnet. Near the bottom of the section, to the west of the old Dominion Steel Company Limited (DOSCO) quarry outcropping on the coast near the White Rock Formation-Meguma Group contact, metamorphosed silty slates and siltstones have been subjected to severe folding and shearing and thin quartz lenses have been tectonically attenuated and in part boudinaged.

A high percentage of silica orthoquartzite beds pinch and swell along strike and may in places be discontinuous lenses. Several vertical faults appear to have displaced the orthoquartzite bed at different places between Chegoggin Point and Lake George and the bed may have also pinched out in sections.

PREVIOUS WORK

The study area was first mentioned in reports published by the Geological Survey of Canada and the Province of Nova Scotia with most of the early attention paid to gold production at Chegoggin Point and Cranberry Head. Included among these reports are several by Faribault who discussed relationships of the White Rock Formation quartzite and the adjacent rocks (Faribault, 1919). Taylor (1967) conducted a study and published a map for the Geological Survey of Canada.

From 1947-1963, DOSCO quarried approximately 100 000 t of high grade silica for use in silica brick manufacture at its steel plant in Sydney. In 1963, the Nova Scotia Department of Mines completed an exploration and drilling project on the silica deposit and a preliminary report by Jones (1963) is available in the NSDME library.

From 1965-1969 a company known initially as General Silica and later as National Silica staked the property and conducted further diamond drilling and a magnetometer survey over the property in 1968. A preliminary report by Behre Dolbear and Company (1965) and the magnetometer results of Keevil Mining Group Limited (Sharpley, 1968) are available at the NSDME library, Halifax.

In 1985 the property was staked by Scotsville Mineral Resources Limited and during the summer of 1985 Elkem Metals Limited dug two trenches on the property in order to obtain fresh samples for testing in its laboratories. In 1987 the 76 claims that control the known and assumed outcropping of the quartzite were put under closure by NSDME to enable this in house exploration program to be conducted.

RECENT PROGRAM

Since the controlling claims of the silica deposit were placed under closure by NSDME in early 1987 geological mapping, geophysical profiling, diamond drilling and assaying programs have been completed. The almost complete lack of outcrop necessitated the need to find another method to trace the subcropping quartzite. During the spring of 1987, Eastern Geophysical Company Limited was contracted to determine which geophysical method could be used to help trace the high grade silica bed from its known location at Chegoggin Point to a second known outcropping 16 km away at Lake George. Previous work included magnetometer and S.P. surveys (Sharpley, 1968), but unfortunately these were not successful in tracing the quartzite. It was recommended in that report (Sharpley, 1968) that various geophysical techniques, including radam and resistivity be employed in an effort to trace the quartzite.

GEOPHYSICAL PROGRAM

The first site chosen as a test of the response of the various geophysical methods was at Chegoggin Point across the strike of the quartzite bed adjacent to the old DOSCO quarry. Magnetometer and EM-VLF surveys failed to show any response when passing over the known quartzite bed. The induced polarization survey using a Phoenic IPT-1 and IPV-1, did indicate areas of increased resistivity over the known location of the quartzite bed along the face of the quarry, but the degree of resistance was low compared to other pure quartzite deposits. The low resistivity is now thought to have been caused by abundant disseminated pyrite contained within the bedrock.

For this initial stage, seven sites were chosen along the assumed strike extension of the quartzite bed between Chegoggin Point and Lake George. Fortunately, many roadways cross the assumed strike extension of the quartzite bed and it was along the right of way of such roadways that the geophysical lines were run. The seven sites were: the old DOSCO quarry at Chegoggin Point, McCormack Road, Rodney Road, Highway 101 and three lines were run along woods roads west of Lake George. Although the resistance numbers were again low, there was a distinct signature on most profiles which corresponded to the results over the known quartzite location at Chegoggin Point. The location of these signatures was near the assumed strike extension and, in most cases, there was quartz float nearby (Figs. 2 and 3).

A second stage of the geophysical program was initiated to better define the resistivity highs along some of the profiles. Three additional geophysical lines were run. On one (line 2+00) along Trans-Canada Highway 101 a closer spacing of the electrodes from 25 m down to 10 m was used. Two lines were run in areas not previously surveyed. One of these areas, adjacent to CH-LG-87-5, contains abundant large pieces of quartz float and occurs on the assumed strike extension of the quartzite bed. The third geophysical line was run adjacent to CH-LG-87-9. These final three geophysical lines were for exploration purposes and were not surveyed into the grid.

Based on the results of the geophysical surveying and the followup drilling program, it appears that resistivity profiling is not a reliable means of locating the silica deposit. Drillholes targeted for these areas did not intersect any appreciable amounts of quartzite.

DIAMOND DRILLING PROGRAM

During 1987, nine diamond-drill holes were completed between Chegoggin Point and Lake George, Yarmouth County, using NSDME drills numbers 15 and 20, a Longyear 38 and a Boyles Brothers 37. The almost complete lack

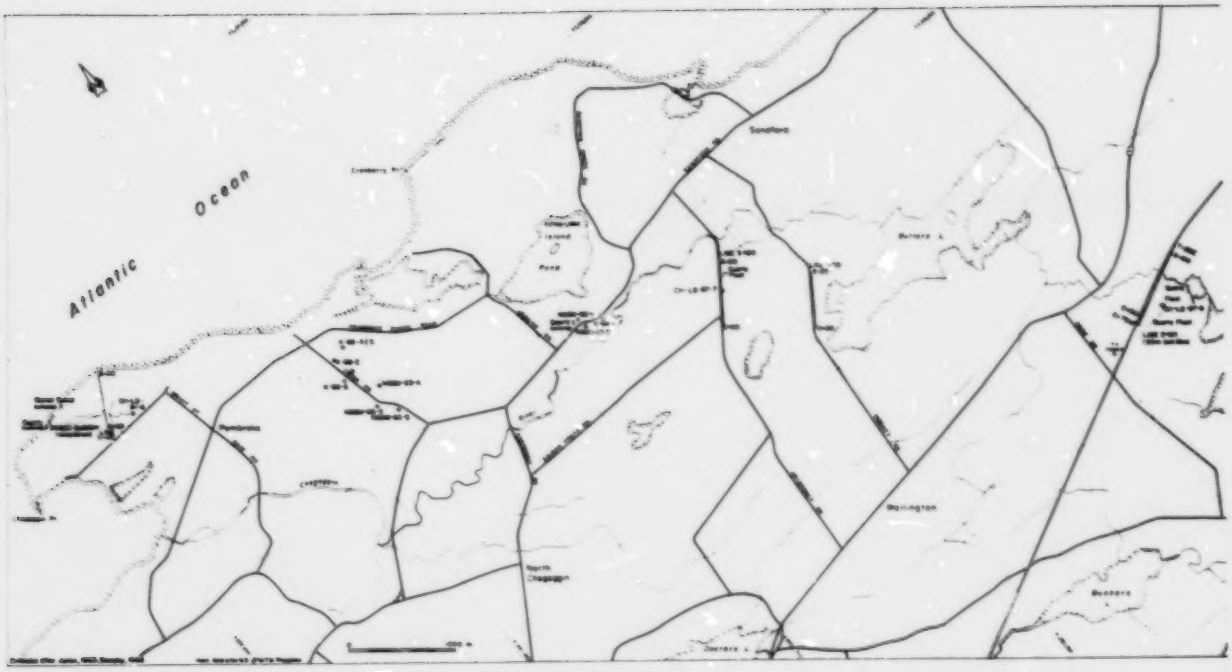

Figure 2. Location map of drillholes and seismic lines for the Chegoggin Point, Lake George silica deposit, Yarmouth County (This map is also available at scales of 1:10 000 and 1:20 000 in the Nova Scotia Department of Mines and Energy Libraries as a supplement to OFR 90-009.)

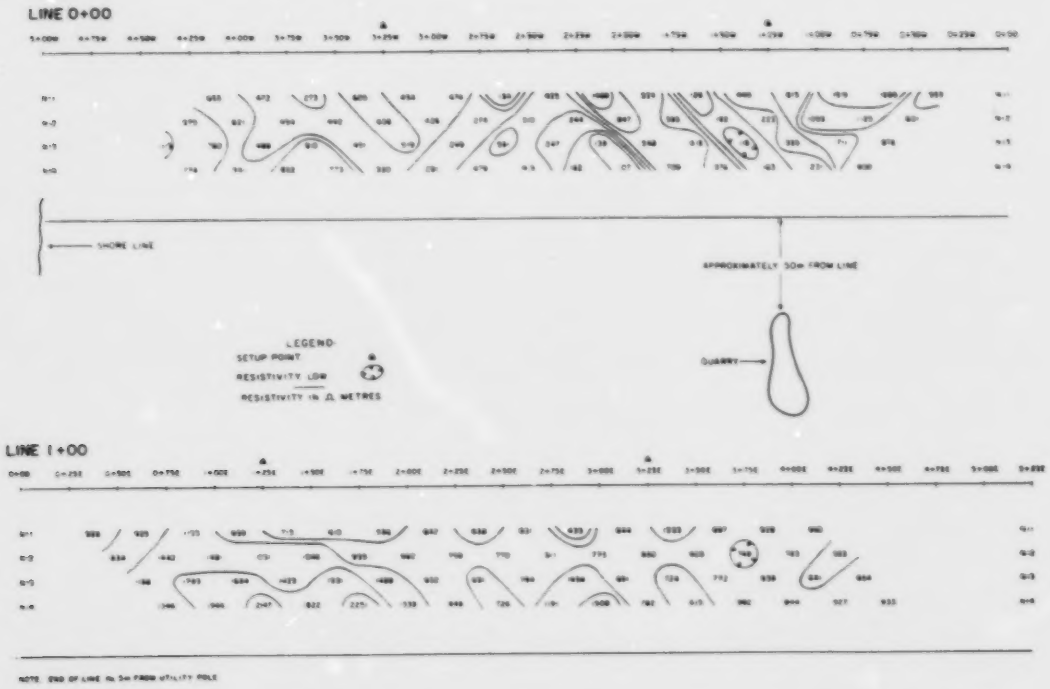

Figure 3. Seismic profiles, 1987, for the Chegoggin Point, Lake George silica deposit, Yarmouth County (These seismic profiles are available at a larger scales in the Nova Scotia Department of Mines and Energy Libraries as a supplement to OFR 90-009.)

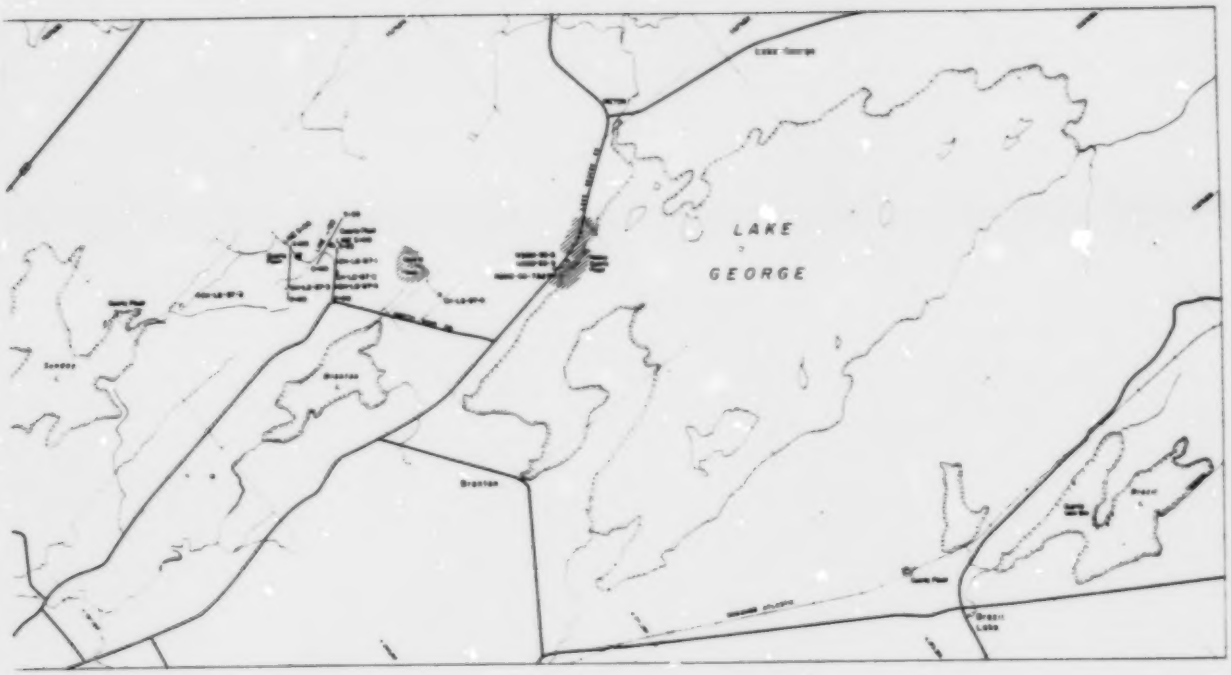

Figure 2. Continued.

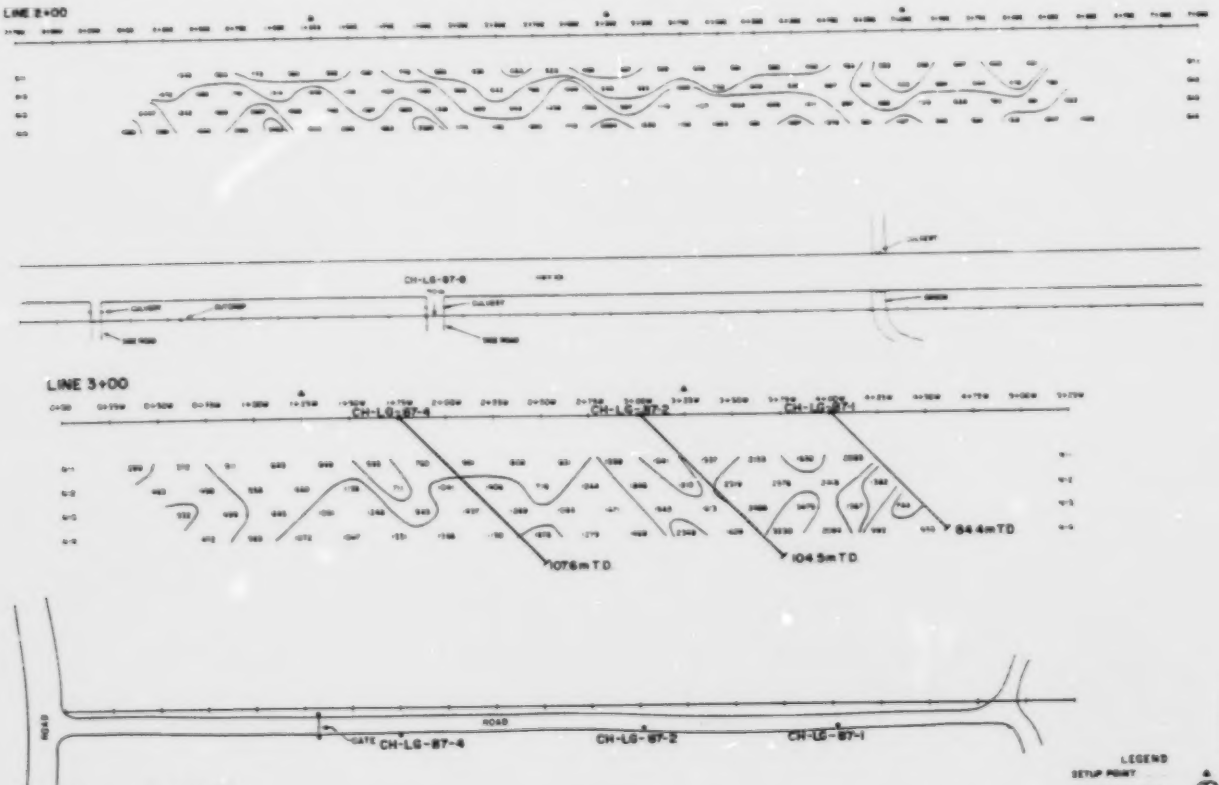

Figure 3. Continued.

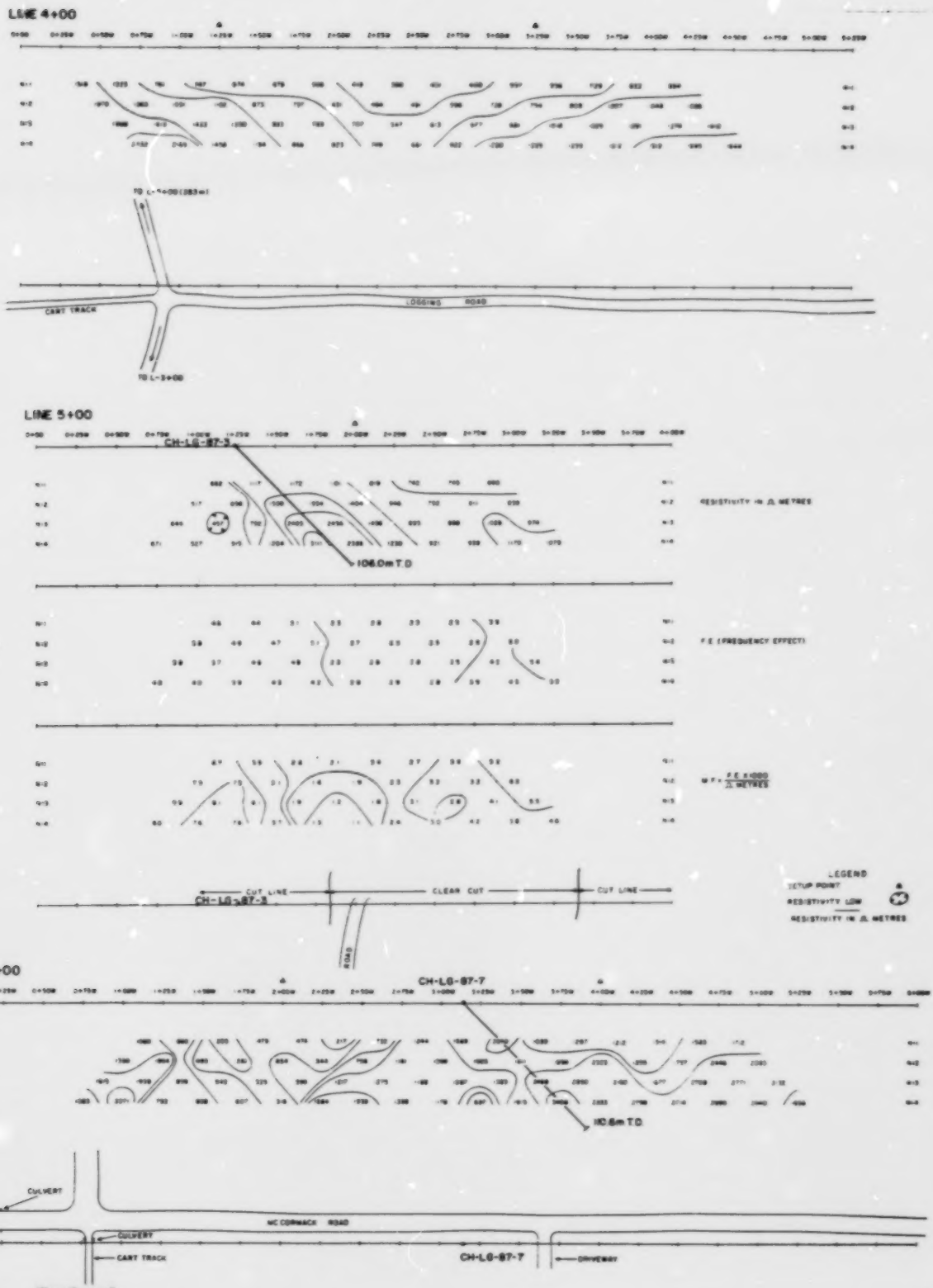

Figure 3. **Continued.**

of outcrop necessitated the need to use alternate methods to locate drill targets. The following three factors were used: the results of the geophysical surveys completed; the presence of abundant quartz float nearby; and the site being near the assumed strike extension of the exposed quartzite bed at Chegoggin Point and Lake George. All holes were angled at 45° on an azimuth of 310° in order to intercept the steeply dipping quartzite bed which strikes 20° east.

Drillhole CH-LG-87-1 was sited to intersect a resistivity high along geophysical line 3+00 (Appendix 1). It was drilled to 84.4 m (277 ft). Unfortunately no great thickness of quartzite was intersected, only a few thin (<1 m) quartz veins. Drillhole CH-LG-87-2 was sited to intersect the sequence adjacent to, and to overlap, the rocks intersected in CH-LG-87-1 (Fig. 2) and also to penetrate the same resistivity high. It was drilled to 104.5 m (343 ft), but again no quartzite beds of any thickness were penetrated. A third hole, CH-LG-87-4, was sited along the same line in order to penetrate rocks adjacent to drillhole CH-LG-87-2 and overlap the same. It was drilled to 107.6 m (353 ft) and a 48.5 m (160 ft) section of dark grey, impure quartzite was intersected. This bed falls on the assumed strike extension of the quartzite bed on the western shore of Lake George which was intersected by previous drillholes (Jones, 1963). Whether this quartzite body is part of the same bed as the outcrop at Lake George is questionable due to the distance between the two localities (+3 km) and the very different appearance of the two beds. It may be assumed that this bed of dark grey quartzite is the high resistivity signature appearing on the profile of geophysical line 4+00.

Drillhole CH-LG-87-3 was sited 450 m southwest of drillhole CH-LG-87-4 and was drilled to 104.5 m (343 ft) and aligned to intersect a very definite resistivity high on geophysical line 5+00. A thin 2.3 m thick quartz bed was penetrated. Drillholes CH-LG-87-5 and CH-LG-87-9 were drilled in the same area targeted along strike of previous drillholes and in areas of abundant quartzite float, but neither hole intersected any significant amounts of quartzite. Drillholes CH-LG-87-5 and CH-LG-87-9 were drilled to 119.8 m (393 ft) and 147.2 m (483 ft), respectively

Drillhole CH-LG-87-6 was sited just northeast of the abandoned quarry at Chegoggin Point. It was drilled to 153.3 m (503 ft) and provided a previously unavailable section through the quarried quartzite beds for assay and reserve calculations. Over 60 m of quartzite were intersected with the two largest beds being 35 m and 18.5 m thick. The quality ranges from extremely high grade (+99% SiO_2) to impure. A garnet-rich biotite schist bed over 4 m thick and containing approximately 20% almandine was intersected below the quartzite beds. This may be the same garnet-rich bed seen outcropping along the shoreline and, if so, it has been displaced by faulting.

Drillhole CH-LG-87-7 was sited to intersect a geophysical high along line 6+00 on McCormack Road and drillhole CH-LG-87-8 was sited near a geophysically defined target on line 2+00 along Trans-Canada Highway 101. Although there was abundant quartz float nearby these drillholes did not intersect any significant amounts of silica.

CHEMICAL COMPOSITION

Drill core samples collected were geologically logged and sections containing silica and other minerals of interest were split and assayed. The core was sampled in five foot intervals and spectrographic analyses were run on all the samples. Sixty-four samples were analyzed by this means and after reviewing the results, 41 samples were further assayed for SiO_2, Al_2O_3, K_2O, Fe_2O_3, MgO and CaO; two samples for Au and Ag and one for P_2O_5. The 41 samples represent 61.42 m (201.5 ft) of drillcore cut in drillhole CH-LG-87-6. The average SiO_2 percentage for the entire interval (61.42 m (201.5 ft)) is 93.95% with values ranging from 87.72-99.19% per five foot interval. The results of the assays are included in Appendix 2. Two samples that indicated trace amounts of silver on the spectrographic analysis were assayed for gold and silver, but results indicated only 0.2 and 0.4 ppm silver and 13 and 15 ppb gold. Another sample visually contained phosphorus and was assayed for P_2O_5 but contained only 0.76% over a 1.2 m (4 ft) interval.

BULK SAMPLING PROGRAM

On October 15, 1987, a bulk sample of the garnet schist was taken from the outcrop along the shoreline at Chegoggin Point. A John Deere 940 track mounted excavator was used to extract approximately 1360 kg of ore which was loaded into 12 shipping barrels and taken to Stellarton for storage. Another 9 kg sample was forwarded to the Mineral Processing Laboratory at CANMET in Ottawa for testing (Andrews, 1988). See Appendix 3 for results.

Approximately 180 kg of silica boulders were taken from the shoreline and transported to Stellarton for storage.

SUMMARY AND CONCLUSIONS

The rocks of the Chegoggin Point-Lake George area are assigned to the White Rock Formation (Faribault, 1919) which are preserved within a syncline, the axis of which strikes 20° northeast through Yarmouth Sound. The Formation varies in thickness between 100 and 1000 m and comprises a complex of rock types including metavolcanics, argillites, slates, metasedimentary rocks which in turn include metasiltstones, various schists, and high silica orthoquartzites. The results of this project and previous work indicate silica rich orthoquartzite beds of varying thicknesses that have been tectonically displaced along strike and may continue to be extremely difficult to trace economically. Nevertheless, there are portions of these particular beds that are large and continuous enough to yield deposits of extremely high grade silica having reserves of millions of tonnes that can be extracted economically. The most attractive of these outcrops on deep tidal water at Chegoggin Point and continues inland past Footes Corner for approximately 5000 m. The orthoquartzite bed, which appears to be repeated by faulting along the shoreline, outcrops in excess of 60 m thick at the shoreline. This thickness was repeated in drillhole CH-LG-87-6 located approximately ±800 m inland past the abandoned DOSCO quarry. A bed of impure quartzite approximately 21 m thick was intersected in a diamond-drill hole in 1968 (K-68-4) at the Cross Road, approximately 2500 m from the outcropping at Chegoggin Point (Sharpley, 1968). A diamond-drill hole (NSDM-63-1, 1963) 5000 m along strike from Chegoggin Point intersected 16.8 m of quartzite grading 93.27% SiO_2 over the entire interval (Appendix 4). It can therefore be concluded that the quartzite bed is quite undisturbed along strike for over 5 km although the thickness and quality may vary.

An ore reserve figure of 10 million t is realistic and possible for this block by using a strike length of 5000 m, a thickness of 20 m and a quarrying depth of 40 m (5000 x 20 x 40 x 2.65[1] = 10.6 million t). A few conflicting landuses may make portions of the quartzite bed inaccessible, but these would be offset by the much thicker beds (+50 m) known to occur at Chegoggin Point, and perhaps an increase in depth for the quarrying operation.

Previous drilling along the western shore of Lake George, approximately 16 km from Chegoggin Point, has defined a second block of high grade quartzite. A main objective of this project was to determine if this was the strike extension of the quartzite described above or whether it was an isolated or separated block. The complete lack of outcrop between the two locations necessitated employing alternate means to trace the quartzite bed. Geophysical techniques were employed and initial response on the resistivity I.P. instrument appeared encouraging, but was later proven to be unreliable by followup diamond drilling. Abundant quartz float in the overburden also proved to be an unreliable indicator as to whether the quartzite bed subcrops nearby.

The following conclusions have resulted from previous studies and this program:

1. There are blocks of extremely high grade silica having reserves in the millions of tonnes, the most promising occurring at Chegoggin Point and Lake George.

2. Geophysical methods utilized to date are unreliable to delineate the silica rich quartzite bed.

3. The quartzite bed appears to be discontinuous or technically displaced along strike.

4. Abundant quartz float in an area does not guarantee that the quartzite bed subcrops nearby.

5. There exists a garnet schist deposit containing 40-50% almandine which appears to be discontinuous or tectonically displaced along strike adjacent to the quartzite bed. Reserves of 500 000 t are estimated.

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[1]specific gravity of silica.

Silica is becoming a much sought after commodity especially in deposits of high purity, large tonnage and where development and transportation to markets are economical. It is hoped that this work has added data to encourage further exploration of this high grade, high potential deposit and has helped to better define what direction a future program will take.

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APPENDIX 1.

DRILL LOGS FOR DIAMOND-DRILL HOLES CH-LG-87-1 TO CH-LG-87-9

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property:	Chegoggin Point, Lake George	**Section:**	0-84.4 m (0-277 ft)
Hole Number:	CH-LG-87-1	**Azimuth:**	310°
Latitude:	43°58'2.60823"	**Dip:**	45°
	3° MTM 178082.548 m (584260.328 ft)	**Started:**	June 29, 1987
Longitude:	66°04'44.89091"	**Completed:**	July 15, 1987
	3° MTM 4870708.381 m (15980014.373 ft)	**Ultimate Depth:**	84.4 m (277 ft)
Elevation:	46.51 m (152.59 ft)	**Proposed Depth:**	106.7 m (350 ft)

Depth in metres (feet)	Formation
0-6.7 (0-22)	OVERBURDEN.
6.7-28.9 (22-95)	PELITIC SCHIST: medium green grey with thin pure orthoquartz beds. Foliated, calcite infilling narrow fractures, pyrite in places.
28.9-46.9 (95-154)	BIOTITE SCHIST: black to dark green; foliated, many thin veins of silica; sills or thin flow sheets in places (chloritic, with quartz veins and abundant pyrite usually at contacts),some sections very chloritic and some massive biotite, trace hornblende in thin layers, calcite in fissures.
46.9-47.5 (154-156)	SILICA: white clear, interlayers of wall rock, sulphides pyrite, chalcopyrite, pyrrhotite.
47.5-51.5 (156-169)	PELITIC SCHIST: medium grey, layered, 20° to core axis, thin biotite-rich beds, few quartz stringers.
51.5-53.0 (169-174)	GARNET SCHIST: abundant clear quartz at top, almandine garnets are 0.1-1 cm in diameter. 40% in places, 25% of entire section.
53.0-79.9 (174-262)	PELITIC SCHIST: medium grey, contains many zones of flow-like features near some contacts, abundant thin layers of pyrite, trace chalcopyrite, pyrrhotite, thin sections of massive biotite. Chloritic in part, few quartzite stringers, calcite infilling fissures.
79.9-80.8 (262-265)	FELSIC METAVOLCANIC: (flow sheet) (sill?), laths of fine grained biotite, very chloritic in part, abundant hair like layers of pyrite at contacts.
80.8-84.4 (265-277)	BIOTITE SCHIST: medium grey to black, abundant fine grained biotite in few sections, few thin quartz veinlets in places; pyrite, some thin layers of very fine grained muscovite.

Drilling Performed by: Nova Scotia Department of Mines and Energy **Geologist:** R. MacDonald

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property:	Chegoggin Point, Lake George	**Section:**	0-104.5 m (343 ft)
Hole Number:	CH-LG-87-2	**Azimuth:**	310°
Latitude:	43°58'0.67223"	**Dip:**	45°
	3° MTM 178173.670 m (584559.285 ft)	**Started:**	July 16, 1987
Longitude:	66°04'40.74171"	**Completed:**	August 6, 1987
	3° MTM 4870646.868 (15979812.559 ft)	**Ultimate Depth:**	104.5 m (343 ft)
Elevation:	45.88 m (150.52 ft)	**Proposed Depth:**	104.5 m (343 ft)

Depth in metres (feet)	Formation
0-7.0 (0-23)	OVERBURDEN.
7.0-10.1 (23-33)	GARNET PELITIC SCHIST: medium grey with abundant fine garnets. At 7.7 m (25.3 ft) a 5.0 cm (2 in) vein of silica at 30° to core axis.
10.1-11.0 (33-36)	MICA SCHIST: fine grained muscovite with few intrusions of silica, Fe staining along fractures.
11.0-19.5 (36-64)	ANDESITE: contains many radial clusters of actinolitic hornblende, trace garnet, quartz, biotite, calcite.
19.5-23.8 (64-78)	MICA SCHIST: very fine grained muscovite with few platy intrusions of pyrite.
23.8-24.4 (78-80)	SILICA: white to translucent, with inclusion of wall rock, pyrite along some fissures.
24.4-26.4 (80-86.5)	PELITIC SCHIST: black to dark grey, laminated biotite at 70° to core axis. Contains 2-5 mm wide veinlets of quartz with later calcite infilling of fissures.
26.4-32.0 (86.5-105)	GARNET MICA SCHIST: medium to light grey laminations at 60° to core axis of quartz and biotite. 5.0 cm (2 in) very pure silica band at 31.2 m (102.5 ft). Garnet 5-10% with a few grains up to 5 mm in diameter. Minor chlorite.
32.0-36.6 (105-120)	PELITIC SCHIST: abundant biotite-chlorite laminations with very few intrusions of silica. Minor pyrite and calcite infilling of fissures.
36.6-41.1 (120-135)	MICA SCHIST: light to medium grey, soft with 1-2 mm grains of kyanite.
41.1-46.6 (135-152.8)	ACTINOLITE SCHIST: medium to dark green grey, well developed lineation at 60° to core axis, abundant pyrite, Fe stained in places. Calcite along fissures.
46.6-47.2 (152.8-155)	SILICA: white, very pure, with very minor inclusions of wall rock, possible 5-7 cm (2-3 in) parting of garnet schist, silica is broken.
47.2-50.0 (155-164)	ACTINOLITE SCHIST: dark to medium green grey as above.
50.0-50.6 (164-166)	SILICA: as above with inclusions of wall rock (mainly biotite schist).
50.6-104.5 (166-343)	PELITIC SCHIST: medium grey with thin, very pure orthoquartzite beds, foliated with fractures filled with calcite, abundant pyrite (~25%) in thin layers infilling fractures.

Drilling Performed by: Nova Scotia Department of Mines and Energy **Geologist:** R. MacDonald

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property:	Chegoggin Point, Lake George	**Section:**	0-104.5 m (0-343 ft)
Hole Number:	CH-LG-87-3	**Azimuth:**	310°
Latitude:	43°57'46.15512"	**Dip:**	45°
	3° MTM 178000.498 m (583991.135 ft)	**Started:**	August 11, 1987
Longitude:	66°04'48.13565"	**Completed:**	August 25, 1987
	3° MTM 4870202.000 m (15978353.018 ft)	**Ultimate Depth:**	104.5 m (343 ft)
Elevation:	39.73 m (130.35 ft)	**Proposed Depth:**	106.7 m (350 ft)

Depth in metres (feet)	Formation
0-8.5 (0-28)	OVERBURDEN.
8.5-11.0 (28-36)	PELITIC SCHIST: light grey, fine grained mica, silty in part, bedding planes at 30° to core axis, abundant cordierite and andalusite crystals in some sections.
11.0-13.3 (36-43.6)	AMPHIBOLE-BIOTITE SCHIST: (greenstone) (sill?).
13.3-19.5 (43.6-64)	PELITIC SCHIST: as above, some pyrite infilling along old bedding planes.
19.5-28.3 (64-93)	SLATE: silty throughout with abundant pyrite; schisty in sections.
28.3-42.1 (93-138)	PELITIC SCHIST: as above, crystals of andalusite and cordierite throughout, abundant pyrite. Thin quartz veins at 20° to core axis at 28.7 m (94 ft), some garnet near quartz, sections are laminated light to medium grey, badly broken in sections.
42.1-43.6 (138-143)	METAVOLCANIC ROCKS: very altered sections with thin intrusions of quartz, sections laminated at 20° to core axis, calcite infilling vugs and fractures, pyrite disseminated throughout (flow sheet?) (sill?).
43.6-55.5 (143-182)	BIOTITE SCHIST: fine- to coarse-grained sections of abundant coarse grained biotite, thin quartz intrusions with brecciated wall rock inclusions. Alteration severe in sections.
55.5-65.5 (182-214.8)	CHLORITE SCHIST: light green matrix with dark green amphibole crystals interbedded with dark green schist, sections of altered quartz cobbles (metaconglomerate). Few quartz veinlet intrusions contained brecciated wall rock, abundant pyrite throughout. Volcanics massive.
65.5-73.5 (214.8-241)	METASEDIMENTARY ROCKS: with abundant thin intrusions of quartz (one thick SILICA vein from 71.2-73.5 m (233.5-241 ft) with wall rock inclusions) fine grained disseminated pyrite and chalcopyrite in vugs and wall rock contacts.
73.5-85.3 (241-280)	VOLCANIC ROCKS: greenstone amphiboles, siliceous in part, fractures with calcite infilling; massive.
85.3-96.6 (280-317)	METAARENITE: dark green grey, siliceous, massive, hard, fine grained, disseminated pyrite, pyrrhotite, chalcopyrite throughout. Calcite and pyrite infilling along fractures, grades schisty-silty.
96.6-97.1 (317-318.5)	QUARTZ VEIN: with wall rock breccia, mica schist.
97.1-104.5 (318.5-343)	MICA SCHIST: light grey, laminated to dark grey, at 30° to core axis, fine grained with pyrite, soft with greasy feel in places, shaly at bottom.

Drilling Performed by: Nova Scotia Department of Mines and Energy **Geologist:** R. MacDonald

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property:	Chegoggin Point, Lake George	**Section:**	0-107.6 m (0-353 ft)
Hole Number:	CH-LG-87-4	**Azimuth:**	310°
Latitude:	43°57'57.64045"	**Dip:**	45°
	3° MTM 178262.861 m (584851.906 ft)	**Started:**	August 26, 1987
Longitude:	66°04'36.67021"	**Completed:**	September 21, 1987
	3° MTM 4870551.564 m (15979499.882 ft)	**Ultimate Depth:**	107.6 m (353 ft)
Elevation:	45.30 m (148.62 ft)	**Proposed Depth:**	106.7 m (350 ft)

Depth in metres (feet)	**Formation**
0-15.2 (0-50)	OVERBURDEN: sandy with boulders at bottom.
15.2-27.1 (50-89)	BOULDERS: broken bedrock, schists, volcanics, greenstone schist, bedrock, soft, broken.
27.1-28.8 (89-94.5)	VOLCANIC ROCKS: greenstone, flows, pyrite mineralization, (sill?) silty, schisty in places.
28.8-92.0 (94.5-302)	METASEDIMENTARY ROCKS: schists-shaly quartzite, with quartz veins and stringers, few sections of volcanics, breccia flows(?).
43.6-92.0 (143-302)	QUARTZITE: impure, dark grey, shaly in part.
92.0-107.6 (302-353)	MICA SCHIST: pelitic, with cordierite-garnets, flows(?), broken, soft in part, few quartz veinlets and stringers.

Drilling Performed by: Nova Scotia Department of Mines and Energy **Geologist:** R. MacDonald

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property:	Chegoggin Point, Lake George	**Section:**	0-119.8 m (393 ft)
Hole Number:	CH-LG-87-5	**Azimuth:**	310°
Latitude:	43°57'22.84393"	**Dip:**	45°
	3° MTM 177504.604 m (582364.186 ft)	**Started:**	September 23, 1987
Longitude:	66°05'9.76061"	**Completed:**	October 6, 1987
	3° MTM 4869491.834 m (15976023.077 ft)	**Ultimate Depth:**	119.8 m (393 ft)
Elevation:	41.26 m (135.37 ft)	**Proposed Depth:**	120 m (393.7 ft)

Depth in metres (feet)	Formation
0-19.2 (0-63)	OVERBURDEN: boulders, sandy.
19.2-29.6 (63-97)	METASEDIMENTARY ROCKS: pelitic schist, silty in part, thin beds of garnets (almandine), pyritic, chalcopyrite in part, andalusite crystals.
29.6-67.4 (97-221)	METAVOLCANIC ROCKS: greenstone, biotite, hornfels random, massive pyrite, trace rutile(?), phosphate crystals in places.
67.4-89.2 (221-292.5)	METASEDIMENTARY ROCKS: pelitic schist, light grey laminated, shaly, broken, few quartz veinlets, pyrite in part, cordierite-andalusite crystals in part.
89.2-90.1 (292.5-295.6)	QUARTZ VEIN: smoky to clear, pyrite in part.
90.1-106.4 (295.6-349)	METASEDIMENTARY ROCKS: dark grey black, quartzitic, abundant pyrite; thin quartz veinlets, core badly broken in places, poor recovery.
106.4-119.8 (349-393)	METASEDIMENTARY ROCKS: light to medium grey, pelitic schist, very altered, andalusite crystals and abundant pyrite, thin veinlets of quartz throughout, garnets in part. 110.6-112.8 m (363-370 ft) trace kaolin in some quartz intrusions. Core soft and badly broken, very schisty at 118.9-119.8 m (390-393 ft) T.D.

Drilling Performed by: Nova Scotia Department of Mines and Energy **Geologist:** R. MacDonald

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property:	Chegoggin Point, Lake George	**Section:**	0-69.2 m (0-227 ft)
Hole Number:	CH-LG-87-6	**Azimuth:**	310°
Latitude:	43°51'50.98722"	**Dip:**	45°
	3° MTM 170940.640 m (560828.871 ft)	**Started:**	August 17, 1987
Longitude:	66°09'54.91819"	**Completed:**	September 15, 1987
	3° MTM 4859375.594 m (15942833.314 ft)	**Ultimate Depth:**	153.3 m (503 ft)
Elevation:	10.35 m (33.96 ft)	**Proposed Depth:**	152.4 m (500 ft)

Depth in metres (feet)	Formation
0-5.8 (0-19)	OVERBURDEN.
5.8-7.3 (19-24)	FELSIC METAVOLCANIC: (flow sheet?), matrix of fine grained biotite, very chloritic in part (random orientated hornfels), flecks of pyrite throughout.
7.3-9.1 (24-30)	PELITIC SCHIST: medium to dark green, very fine biotite, silty, foliated, very thin layers of fine grained pyrite disseminated throughout.
9.1-16.0 (30-52.6)	FLOW SHEET: metabasite, tuff altered amphibole-biotite schist with altered quartz pebbles in part (metaconglomerate), some pyritic flecks.
16.0-16.4 (52.6-53.9)	QUARTZ VEIN: white smoky, fractured with clast of wall rock, pure in part.
16.4-32.3 (53.9-106)	METAVOLCANIC ROCKS: as above, matrix of fine grained biotite, pyrite in places, chloritic.
32.3-38.1 (106-125)	PELITIC SCHIST: medium to dark grey, very fine biotite layers in sections, weathered in parts, fractured with pyrite.
38.1-39.3 (125-129)	QUARTZ VEIN: white frosted, blocky, broken along fractures.
39.3-40.4 (129-132.5)	METABASITE FLOW: amphibole biotite-schist, abundant pyrite at contact with quartz. 2.5 cm (1 in) quartz stringer at 40.4 m (132.5 ft).
40.4-43.6 (132.5-143)	PELITIC SCHIST: light grey, fine grained mica, silty, laminated, pyrite infilling along bedding at 35° to core axis; at 41.4 m (136 ft) quartz 0.3 m (1 ft) intrusion, pyrite in part.
43.6-44.3 (143-145.3)	QUARTZ VEIN: with thin layers of altered biotite schist at 25° to core axis, very pyritic in places, at 43.6 m (143 ft) 10 cm (4 in) band amphibole-biotite schist.
44.3-46.4 (145.3-152.3)	METABASITE FLOW: amphibole biotite rich schist, broken on fractures.
46.4-65.0 (152.3-213.4)	QUARTZITE: Fe stained, fused, fractured, broken badly in places, finely laminated in sections, trace very fine grained pyrite; at 55.5 m (182 ft) thin laminations perpendicular to core axis; at 58.5 m (192 ft) banded blue/white, pure, fused; at 61.6 m (202 ft) chalcopyrite; at 61.8-62.1 m (202.8-203.8 ft) tuff greenstone; at 62.1 m (203.8 ft) banded quartzite (quartz wacke), kaolin band 15-20 cm (6-8 in), very fine grained quartz wacke.
65.0-69.2 (213.4-227)	METASEDIMENTARY ROCKS: silty slate, broken in places, soft in part, quartz wacke in sections, amphibole-rich flow sheets <0.3 m (1 ft), 0.3 m (1 ft) lost between 64.9-68.0 m (213-223 ft).

69.2-71.3 (227-234) (fault?)	TUFF: yellow to buff, altered, greasy, soft, fault goudge, mobile (rods stuck here?) silty in parts; Fe in part.
71.3-74.1 (234-243)	QUARTZ WACKE: very fine grained, abundant pyrite throughout and in fractures, thin laminations at 35° to core axis.
74.1-75.9 (243-249)	QUARTZ VEIN: pure at top grading into quartz arenite at bottom of section, laminations perpendicular to core axis, abundant pyrite throughout and along fractures, very silty near bottom.
75.9-83.1 (249-272.5)	PHYLLITE: medium to dark grey layers at 20° to core axis, broken in part, fractured along bedding. Abundant pyrite (30% more or less) along fractures and throughout. Grades from mudstone to schist, zones of shearing with slickensides. Late calcite infilling.
83.1-86.3 (272.5-283)	QUARTZ VEIN: white to smoky, weathered fractures and vugs, pyrite along fractures and vugs, very altered, soft, very fine grained powdered phyllite at contact.
86.3-99.0 (283-324.7)	PHYLLITE: grades between a soft silty slate to very fine grained schist with fine grained mica in places; soft, broken bedding at 20° to core axis, abundant pyrite along bedding planes and fractures, vuggy (weathered) sheared zones, microfolds in sections, slickensides, graphitic (flake) in part.
99.0-102.4 (324.7-336)	QUARTZITE: impure at top 0.6 m (2 ft), banded at 10° to core axis, becoming very pure, white, few fractures with pyrite infilling thin sections of schistosity.
102.4-110.6 (336-363)	QUARTZITE: medium grey, microfractures at 10° to core axis, some pyrite infilling along fractures, impure quartzite grades to quartz arenite in places.
110.6-115.5 (363-379)	QUARTZITE: impure, silty, vuggy, fractured along bedding planes at 60° to core axis.
115.5-121.6 (379-398.9)	QUARTZITE: medium grey to smoky, fractured, old bedding planes at 45° to core axis, vuggy, weathered along bedding (kaolin removed?), pyrite along some planes, cherty in part.
121.6-137.5 (398.9-451)	QUARTZITE: blue grey, impure, microfractures at 10° to core axis infilled with pyrite grains <0.2 mm, silty, schist in part, abundant fine grained disseminated pyrite throughout, 138.6 m (435 ft) mineralization pyrite, pyrrhotite, rutile, sometimes in 20-30 mm bands at 10° to core axis; at 128.9-132.0 m (423-433 ft), 2.4 m (8 ft) lost core; at 132.0-135.0 m (433-443 ft) schistosity at 10° to core axis.
137.5-137.9 (451-452.6)	METAWACKE: silty, schisty in places, siliceous, fractured with and across ancient bedding(?), abundant pyrite infilling, silty-shale in places, noncalcareous.
137.9-139.1 (452.6-456.5)	GARNET-BIOTITE SCHIST: green with garnets (almandine) 20% (more or less), laminated at 15° to core axis, with abundant pyrite; sections are amphibole rich (flowsheets), sections of fine grained biotite, garnets are randomly dispersed throughout.
139.1-141.3 (456.5-463.5)	AMPHIBOLE-BIOTITE SCHIST: (greenstone) ancient bedding at 15° to core axis, abundant fine grained pyrite along bedding and fractures, few garnets.
141.3-142.0 (463.5-466)	GARNET-BIOTITE SCHIST: as above, laminated abundant pyrite infilling.
142.0-142.3 (466-467)	BIOTITE SCHIST: dark grey to black, graphitic, abundant pyrite, sheared, 5 cm (2 in) quartz vein at 142.3 m (466.7 ft), vuggy.

142.3-153.3 (467-503) PELITIC SCHIST: light grey, fine grained mica, cordierite in sections, laminated at 15° to core axis.

Drilling Performed by: Nova Scotia Department of Mines and Energy **Geologist:** R. MacDonald

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property:	Chegoggin Point, Lake George	**Section:**	0-77.9 m (0-255.6 ft)
Hole Number:	CH-LG-87-7	**Azimuth:**	310°
Latitude:	43°54'34.11474"	**Dip:**	45°
	3° MTM 173506.675 m (569247.621 ft)	**Started:**	September 28, 1987
Longitude:	66°08'4.45924"	**Completed:**	October 6, 1987
	3° MTM 4864360.643 m (15959188.461 ft)	**Ultimate Depth:**	110.6 m (363 ft)
Elevation:	16.64 m (54.59 ft)	**Proposed Depth:**	122 m (400 ft)

Depth in metres (feet)	Formation
0-6.4 (0-21)	OVERBURDEN.
6.4-18.9 (21-62)	METASEDIMENTARY ROCKS: pelitic schist, light to medium grey, schistosity at 50° to core axis, laminated, thin layers of biotite flakes, cordierite and few andalusite crystals, core badly broken in places.
18.9-19.8 (62-65)	METAVOLCANIC ROCKS: greenstone, amphibole crystals, 7.5 cm (3 in) quartz vein at 19.0 m (62 ft).
19.8-26.0 (65-85.3)	METASEDIMENTARY ROCKS: pelitic schist as above, clasts elongated, schistosity at 50° to core axis.
26.0-27.0 (85.3-88.6)	METAVOLCANIC ROCKS: as above.
27.0-29.0 (88.6-95)	METASEDIMENTARY ROCKS: as above.
29.0-29.1 (95-95.6)	METAVOLCANIC ROCKS: amphibolite
29.1-30.1 (95.6-98.6)	METASEDIMENTARY ROCKS: as above.
30.1-30.5 (98.6-100)	QUARTZ VEIN: with some wall rock intrusions.
30.5-43.3 (100-142)	METASEDIMENTARY ROCKS: as above, thin laminations with thin layers of biotite, abundant elongated clasts.
43.3-43.6 (142-143)	GARNET SCHIST: almandine garnets 20% (more or less), abundant pyrite.
43.6-66.4 (143-218)	METASEDIMENTARY ROCKS: as above, pelitic schist, few thin bands of garnets less than 2.5 cm (1 in).
66.4-66.8 (218-219)	METAVOLCANIC ROCKS: greenstone, amphiboles, badly sheared, broken, slickensides, with calcite veinlets, abundant pyrite crystals.
66.8-77.4 (219-254)	METASEDIMENTARY ROCKS: as above, pelitic schist, ancient bedding structure, microfolding, sections of metavolcanics, amphibolite.
77.4-77.9 (254-255.6)	QUARTZ VEIN: smoky with inclusions of wall rock, pyrite in places.

77.9-110.6 (255.6-363) METASEDIMENTARY ROCKS: as above, laminated, abundant pyrite in places, garnets at 78.0 m (256 ft), very altered in places, crystals of cordierite, biotite at 70° to core axis.

Drilling Performed by: Nova Scotia Department of Mines and Energy **Geologist:** R. MacDonald

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property:	Chegoggin Point, Lake George	**Section:**	0-152.4 m (0-500 ft)
Hole Number:	CH-LG-87-8	**Azimuth:**	315°
Latitude:	43°56°17.87495"	**Dip:**	45°
	3 MTM 176209.672 m (578115.722 ft)	**Started:**	September 16, 1987
Longitude:	66°06'6.09824"	**Completed:**	September 24, 1987
	3° MTM 4867511.066 m (15969524.495 ft)	**Ultimate Depth:**	152.4 m (500 ft)
Elevation:	30.22 m (99.15 ft)	**Proposed Depth:**	152.4 m (500 ft)

Depth in metres (feet)	Formation
0-5.2 (0-17)	OVERBURDEN.
5.2-7.3 (17-24)	QUARTZITE: impure, shaly-schisty, vuggy, Fe stained, weathered.
7.3-19.5 (24-64)	METAVOLCANIC ROCKS: greenstone amphibole-biotite schist with numerous quartz veinlets broken and brecciated in part, sheared in part.
19.5-28.3 (64-93)	QUARTZITE: dark grey, impure, (quartz arenite) silty, quartz veinlets with pyrite, fractured, calcite infilling, sheared.
28.3-38.1 (93-125)	VOLCANIC ROCKS: greenstone, amphibole-biotite, altered, fused quartz pebbles (metaconglomerate), laminated quartz veinlets, pyrite in part.
38.1-69.5 (125-228)	QUARTZITE: (quartz arenite), impure, silty, chloritic in part, schisty, sheared, fine grained pyrite.
69.5-83.8 (228-275)	PELITIC SCHIST: silty, laminated (old bedding?), crystals of cordierite-andalusite, sheared in places. Fractured with abundant pyrite, few thin sections of volcanics (flow sheets?), few thin quartz veins.
83.8-85.0 (275-279)	QUARTZITE: dark grey, impure with quartz veins in part, vuggy, fractured with abundant pyrite, trace pyrrhotite.
85.0-110.3 (279-362)	VOLCANIC ROCKS: greenstone, amphibole-biotite rich, schisty, amphibolitic, sections of silty quartz arenite, schisty in part with abundant pyrite.
110.3-115.2 (362-378)	METASEDIMENTARY ROCKS: quartzite, impure, sheared with pyrite, laminated in sections (old bedding fractures?), schisty, grades into phyllite.
115.2-152.4 (378-500)	MICA SCHIST: pelitic, fine grained, soft, crystals of cordierite, andalusite in part, quartz veinlets, 45 cm (1.5 ft) at 119.8 m (393 ft), shaly in part, bedding fractures, retained in places. Quartz vein at 137.8 m (452 ft), vuggy with kaolin in part, broken, wall rock inclusions, weathered feldspar to kaolin.

Drilling Performed by: Nova Scotia Department of Mines and Energy **Geologist:** R. MacDonald

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property:	Chegoggin Point, Lake George	**Section:**	0-147.2 m (0-483 ft)
Hole Number:	CH-LG-87-9	**Azimuth:**	310°
Latitude:	43°58'21.04994"	**Dip:**	45°
	3° MTM 178936.895 m (587063.304 ft)	**Started:**	October 8, 1987
Longitude:	60°04'7.04838"	**Completed:**	October 22, 1987
	3° MTM 4871261.427 m (15981828.829 ft)	**Ultimate Depth:**	147.2 m (483 ft)
Elevation:	42.06 m (137.99 ft)	**Proposed Depth:**	122 m (400 ft)

Depth in metres (feet)	Formation
0-13.4 (0-44)	OVERBURDEN: broken bedrock.
13.4-23.6 (44-77.5)	METASEDIMENTARY ROCKS: pelitic schist, silvery grey, argillaceous with abundant fine grained pyrite, micaceous in part.
23.6-24.4 (77.5-80)	METAVOLCANIC ROCKS: coarse grained, amphiboles, hornblendes with few garnet crystals, pyrite.
24.4-40.6 (80-133.3)	METASEDIMENTARY ROCKS: pelitic schist, silvery grey, soft, argillaceous abundant fine pyrite, few thin quartz veins in places, trace andalusite crystals in places.
40.6-81.7 (133.3-268)	METAVOLCANIC ROCKS: greenstone (gabbro), amphibolitic hornblende rich, few thin layers of quartz, becomes finer grained near bottom of section.
81.7-88.1 (268-289)	METASEDIMENTARY ROCKS: metaargillite, soft, medium to light grey, broken in places, old bedding layers at 20° to core axis, laminated, pyrite disseminated throughout.
88.1-100.0 (289-328)	METASEDIMENTARY ROCKS: dark green to black, slaty, broken, garnets throughout, (5-20% almandine) pyrite, fault at 95.4 m (313 ft), soft, broken, sheared.
100.0-112.2 (328-368)	METASEDIMENTARY ROCKS: metaargillite-slaty-pelitic schist, very altered in sections, some quartz pebbles stretched subparallel to bedding.
112.2-116.1 (368-381)	METAQUARTZITE: dark grey, impure with intrusions of smoky, vuggy quartz, abundant pyrite throughout, appears to be a metaconglomerate in sections.
116.1-147.2 (381-483)	METASEDIMENTARY ROCKS: grades between a metaargillite and impure quartzite, slaty, with thin quartz veins in places, few thin sections of metavolcanic flows which are amphibole-hornblende rich, abundant pyrite in places. Quartz veins 15-30 cm (6-12 in) wide injected in broken rock in sections 136.6-139.6 m (448-458 ft).

Drilling Performed by: Nova Scotia Department of Mines and Energy **Geologist:** R. MacDonald

APPENDIX 2.

ASSAY RESULTS FOR DIAMOND-DRILL HOLE CH-LG-87-6

MINERALS ENGINEERING CENTRE

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30 November, 1987

Nova Scotia Dept. of Mines and Energy
P. O. Box 1087
Halifax, N.S.
B3J 2X1

Attention: P. Luke

RE: Results of analyses on submitted samples.

		Sample		
Interval Fault Zone		70.7-71.1 m (232-233.4 ft)	69.8-70.7 m (229-232 ft)	69.2-69.8 m (227-229 ft)
		87-6-30	87-6-45	87-6-46
SiO_2	%	41.70	28.20	18.91
Al_2O_3	%	30.98	18.47	11.92
Fe_2O_3	%	4.84	24.31	40.57
CaO	%	0.68	1.33	1.02
MgO	%	2.94	3.40	1.79
K_2O	%	1.38	0.71	0.64
Na_2O	%	0.09	0.04	0.04
L.O.I.	%	11.02	16.48	20.59

C. Cole
Minerals Engineering Centre

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11 March 1988

N.S. Department of Mines and Energy
P. O. Box 1087
Halifax, N.S.
B3J 2X1

Attention: B. MacDonald

RE: Results of analyses on submitted samples.

DDH #CH-LG-87-6
Chegoggin Point, Yarmouth County

Sample Interval m (ft)		Sample	SiO_2 %	Al_2O_3 %	K_2O %	Fe_2O_3 %	MgO %	CaO %
46.5-48.0	(152.3-157.3)	87-6-1	96.18	0.36	0.085	0.53	0.053	0.31
48.0-49.5	(157.3-162.3)	2	97.19	0.36	0.16	0.53	0.11	0.42
49.5-51.0	(162.3-167.3)	3	97.30	0.32	0.061	0.46	0.067	0.35
51.0-52.6	(167.3-172.3)	4	98.07	0.22	0.036	0.43	0.05	0.39
52.6-54.1	(172.3-177.3)	5	97.50	0.16	0.12	0.46	0.037	0.35
54.1-55.6	(177.3-182.3)	6	97.53	0.85	0.28	0.40	0.095	0.39
55.6-57.1	(182.3-187.3)	7	97.03	0.35	0.13	0.43	0.015	0.36
57.1-58.7	(187.3-192.3)	8	96.83	0.47	0.13	0.36	0.035	0.45
58.7-60.2	(192.3-197.3)	9	97.00	1.17	0.33	0.40	0.04	0.29
60.2-61.4	(197.3-201.3)	10	96.32	1.18	0.35	0.44	0.037	0.25
43.6-44.3	(143.0-145.3)	11	91.02	2.25	0.36	2.86	0.75	0.45
38.4-40.3	(126.0-132.0)	12	98.02	0.60	0.17	0.74	0.08	0.45
62.5-64.1	(205.0-210.0)	13	99.19	0.28	0.069	0.49	0.08	0.39
61.4-65.1	(201.3-213.4)	14	97.57	0.55	0.21	0.69	0.14	0.31
83.1-86.3	(272.5-283.0)	16	98.72	0.32	0.17	0.83	0.015	0.28
99.0-100.3	(324.7-329.0)	17	98.79	0.37	0.15	0.62	0.14	0.28
100.3-101.7	(329.0-333.4)	18	98.82	0.25	0.30	0.42	0.10	0.32
101.7-103.1	(333.4-338.0)	19	96.71	2.22	0.62	0.64	0.20	0.28
103.1-104.6	(338.0-343.0)	20	93.38	3.31	0.97	0.66	0.11	0.24
104.6-106.1	(343.0-348.0)	21	94.11	2.97	0.84	0.70	0.12	0.42
106.1-107.7	(348.0-353.0)	22	94.94	3.01	0.92	0.76	0.12	0.38
107.7-109.2	(353.0-358.0)	23	95.23	3.30	0.98	1.09	0.15	0.34
109.2-110.7	(358.0-363.0)	24	92.41	3.80	1.17	1.06	0.13	0.34
110.7-112.2	(363.0-368.0)	25	93.61	4.55	1.39	0.53	0.14	0.31
112.2-113.8	(368.0-373.0)	26	91.21	5.12	1.60	0.79	0.18	0.31
113.8-115.3	(373.0-378.0)	27	90.97	4.74	1.40	1.16	0.23	0.31

Sample Interval m (ft)	Sample	SiO_2 %	Al_2O_3 %	K_2O %	Fe_2O_3 %	MgO %	CaO %
115.3-116.8 (378.0-383.0)	28	91.19	4.57	1.26	0.86	0.22	0.36
116.8-118.3 (383.0-388.0)	29	91.64	5.23	1.49	0.54	0.18	0.41
118.3-119.9 (388.0-393.0)	31	90.36	5.94	1.66	0.86	0.23	0.45
119.9-121.7 (393.0-399.0)	32	90.91	6.14	1.71	0.67	0.18	0.38
121.7-122.9 (399.0-403.0)	33	92.44	4.07	1.32	0.94	0.17	0.36
122.9-124.4 (403.0-408.0)	34	92.53	4.62	1.40	0.99	0.23	0.32
124.4-126.0 (408.0-413.0)	35	91.10	4.61	1.45	1.12	0.22	0.27
126.0-127.5 (413.0-418.0)	36	90.60	4.92	1.57	1.09	0.23	0.27
127.5-129.0 (418.0-423.0)	37	90.00	4.58	1.39	1.12	0.23	0.28
129.0-130.5 (423.0-428.0)	38	90.57	4.39	1.30	1.12	0.23	0.29
130.5-132.1 (428.0-433.0)	39	91.60	4.67	1.46	0.83	0.20	0.24
132.1-133.6 (433.0-438.0)	40	87.72	7.32	2.09	1.29	0.33	0.29
133.6-135.1 (438.0-443.0)	41	89.48	6.52	1.85	1.16	0.33	0.29
135.1-136.6 (443.0-448.0)	42	87.87	5.89	1.61	2.50	0.37	0.45
136.6-137.6 (448.0-451.0)	43	88.25	5.81	1.48	2.55	0.35	0.39

Sample Interval m (ft)	Sample	% P_2O_5
38.5-39.7 (126.3-130.3)	87-6-1	0.76

Sample Interval m (ft)	Sample	ppm Ag	ppb Au
74.1-75.9 (243.0-249.0)	87-6-16	0.2	13
142.1-142.4 (466.0-467.0)	87-6-50	0.4	15

C. Cole
Minerals Engineering Centre

CC/jlb

Results of Spectrographic Scans on Samples from 1987 Chegoggin Point-Lake George Diamond Drilling Program

Sample Number	Sample Interval m (feet)	% .0001-.001	.001-.0033	.0033-.01	.01-.1	.1-1	+1
87-3-01	71.2- 72.6 (233.5-237.9)		Cu,Ni	Mn,V,Zr,Cr,Ba,Sr		Fe,Mg,Ca,Ti	Si,Na,Al
87-3-02	72.6- 72.9 (237.9-239.0)	Be,Sc	Cu,Y	Ni	Mn,V,Zr,Cr,Ba,Sr	Mg,Ca,Ti	Si,Fe,Na,Al
87-3-03	72.9- 73.5 (239.0-241.0)		Cu,Sr	Mn,V,Ni,Zr,Cr,Ba	Mg,Ti	Fe,Ca,Al	Si
87-3-04	89.4- 90.8 (293.0-297.6)	Be,Sc	Y	Cu,Ni,Co,Cr	V,Zr,Ba,Sr	Mn	Si,Fe,Mg,Ca,Na,Ti,Al
87-3-05	96.7- 97.1 (317.0-318.5)	Be,Sc	Cu,Y	Ni,Co,La	Mn,V,Zr,Cr,Ba,Sr	Mg,Ca,Ti	Si,Fe,Na,Al
87-4-01	28.4- 28.9 (93.0- 94.6)	Be,Sc	Y	Cu,Ni,Co,Cr	V,Zr,Ba,Sr	Mn	Si,Fe,Mg,Ca,Ti,Al
87-4-02	59.2- 59.5 (194.0-195.0)	Be	Cu,Y	Ni,Sr	Mn,V,Zr,Cr,Co	Mg,Ca,Ti	Si,Fe,Al
87-4-03	53.4- 54.0 (175.0-177.0)	Be,Sc	Cu,Y,Ni	Cr,Sr	Mn,V,Zr,Ba	Mg,Ca,Ti	Si,Fe,Al
87-5-01	38.5- 39.7 (126.3-130.3)	Be,Sc	Y,Cr	Cu,Ni,Co	V,Zr,Ba,Sr	Mn	Si,Fe,Mg,Al,Ca,Na,Ti
87-5-02	89.2- 90.2 (292.5-295.6)	Be	Cu,Sr	Mn,Al,V,Zr,Ba	Ca,Ti,Ni,Cr	Fe,Mg	Si
87-6-01	46.5- 48.0 (152.3-157.3)	Cu	Ni,Ba	Mn,V,Cr	Mg,Ca,Zr	Fe,Al,Ti	Si
87-6-02	48.0- 49.5 (157.3-162.3)	Cu	Ni,Ba	Mn,V,Cr	Mg,Ca,Zr	Fe,Al,Ti	Si
87-6-03	49.5- 51.0 (162.3-167.3)	Cu	Mn,Ni,Ba	V,Ca,Cr	Mg,Al,Zr	Fe,Ti	Si
87-6-04	51.0- 52.6 (167.3-172.3)	Cu	Ba,Sr	Mn,V,Ca,Ni,Cr	Mg,Al,Ti,Zr	Fe	Si
87-6-05	52.6- 54.1 (172.3-177.3)	Cu	Mn,Ni,Ba,Sr	V,Ca,Zr,Cr	Mg,Al,Ti	Fe	Si
87-6-06	54.1- 55.6 (177.3-182.3)	Cu	Sr	Mn,V,Ca,Ni,Zr,Cr,Ba	Mg	Fe,Al,Ti	Si
87-6-07	55.6- 57.1 (182.3-187.3)	Cu	Mn,Sr	Mg,V,Ca,Ni,Zr,Cr,Ba		Fe,Al,Ti	Si
87-6-08	57.1- 58.7 (187.3-192.3)	Cu	Mn,Ba,Sr	V,Ca,Ni	Mg,Zr,Cr	Fe,Al,Ti	Si
87-6-09	58.7- 60.2 (192.3-197.3)	Cu	Sr	Mn,V,Ca,Ni,Cr,Ba	Mg,Zr	Fe,Al,Ti	Si
87-6-10	60.2- 61.4 (197.3-201.3)		Mn,Cu	V,Ca,Ni,Cr,Ba,Sr	Mg,Zr	Fe,Al,Ti	Si
87-6-11	43.6- 44.3 (143.0-145.3)	Sc	Sr	V,Cu,Ni,Zr	Mn,Cr,Ba	Mg,Al,Ca,Ti	Si,Fe
87-6-12	38.4- 40.3 (126.0-132.0)		Cu,Ni,Sr	Mn,V,Zr,Cr,Ba	Mg	Fe,Al,Ca,Ti	Si
87-6-13	62.5- 64.1 (205.0-210.0)	Cu	Ba	Mn,V,Ca,Ni,Zr	Mg,Cr	Fe,Al,Ti	Si
87-6-14	64.1- 65.1 (210.0-213.4)		Cu,Sr	Mn,V,Ca,Ni,Cr,Ba	Zr	Fe,Mg,Al,Ti	Si
87-6-15	74.1- 75.9 (243.0-249.0)		Cu,Sr	Mn,V,Ni,Cr,Ba	Ca,Zr	Fe,Mg,Al,Ti	Si
87-6-16	83.1- 86.3 (272.5-283.0)	Be,Cu,Ag	Mn,Ni,Ba,Sr	Mg,V,Ca,Zr,Cr	Al,Ti	Fe	Si
87-6-17	99.0-100.3 (324.7-329.0)	Cu	Ni,Ba,Sr	Mn,V,Ca,Zr,Cr	Mg,Al,Ti	Fe	Si
87-6-18	100.3-101.7 (329.0-333.4)	Cu	Ni,Ba,Sr	Mn,V,Zr,Cr	Mg,Al,Ca,Ti	Fe	Si
87-6-19	101.7-103.1 (333.4-338.0)	Cu,Sc	Ni,Sr	Mn,V,Zr,Cr,Ba	Ca,Ti	Fe,Mg,Al	Si
87-6-20	103.1-104.6 (338.0-343.0)	Cu,Sc	Y,Ni,Sr	Mn,V,Ca,Cr	Mg,Zr,Ba	Fe,Ti	Si,Al
87-6-21	104.6-106.1 (343.0-348.0)	Cu	Y,Sr	Mn,V,Ca,Ni,Cr,La	Mg,Zr,Ba	Fe,Ti	Si,Al
87-6-22	106.1-107.7 (348.0-353.0)	Cu	Y,Ni,Sr	Mn,V,Ca,Cr	Mg,Zr,Ba	Fe,Ti	Si,Al
87-6-23	107.7-109.2 (353.0-358.0)	Cu	Y,Sr	Mn,V,Ca,Ni	Mg,Zr,Cr,Ba	Fe,Ti	Si,Al
87-6-24	109.2-110.7 (358.0-363.0)	Cu	Y,Sr	V,Ca,Ni,Cr,La	Mg,Mn,Zr,Ba	Fe,Ti	Si,Al
87-6-25	110.7-112.2 (363.0-368.0)	Cu	Mn,Ca,Sr	V,Ni,Cr	Mg,Zr,Ba	Fe,Ti	Si,Al
87-6-26	112.2-113.8 (368.0-373.0)	Cu	Y,Sr	Mn,V,Ca,Ni,Cr	Zr,Ba	Fe,Mg,Ti	Si,Al
87-6-27	113.8-115.3 (373.0-378.0)	Cu	Y,Ni,Cr,Sr	Mn,V,Ca	Zr,Ba	Fe,Mg,Ti	Si,Al
87-6-28	115.3-116.8 (378.0-383.0)	Cu,Sc	Ni,Cr,Sr	Mn,V,Ca	Zr,Ba	Fe,Mg,Ti	Si,Al
87-6-29	116.8-118.3 (383.0-388.0)	Cu	Mn,Ni,Cr,Sr	V,Ca	Mg,Zr,Ba	Fe,Ti	Si,Al
87-6-31	118.3-119.9 (388.0-393.0)	Cu	Ni,Cr,Sr	Mn,V,Ca	Zr,Ba	Fe,Mg,Ti	Si,Al
87-6-32	119.9-121.7 (393.0-399.0)	Cu,Ni	Y,Cr,Sr	Mn,V,Ca	Zr,Ba	Fe,Ti,Mg	Si,Al
87-6-33	121.7-122.9 (399.0-403.0)	Cu,Ni	Y,Cr,Sr	Mn,V	Zr,Ba,Mg,Ca	Ti,Al	Si,Fe
87-6-34	122.9-124.4 (403.0-408.0)	Ni	Y,Cu,Cr,Sr	Mn,V,Ca	Zr,Ba	Fe,Ti,Mg,Al	Si
87-6-35	124.4-126.0 (408.0-413.0)	Cu	Y,Ni,Sr	V,Cr	Mn,Zr,Ba,Ca	Ti,Mg,Al	Si,Fe
87-6-36	126.0-127.5 (413.0-418.0)		Y,Cu,Sr	Mn,V,Ca,Ni,Co,Cr,La	Zr,Ba	Ti,Mg	Si,Fe,Al
87-6-37	127.5-129.0 (418.0-423.0)	Cu,Sc	Y,Sr	Mn,V,Ni,Cr,La	Zr,Ba,Ca	Ti,Mg,Al	Si,Fe
87-6-38	129.0-130.5 (423.0-428.0)		Y,Cu,Sr	Mn,V,Ni,Co,Cr,La	Zr,Ba,Ca	Ti,Mg	Si,Fe,Al
87-6-39	130.5-132.1 (428.0-433.0)		Y,Sr	Mn,V,Cu,Ni,Co,Cr,La	Zr,Ba,Ca	Ti,Mg,Al	Si,Fe
87-6-40	132.1-133.6 (433.0-438.0)	Cu,Sc	Y,Sr	Mn,V,Co,Cr	Zr,Ba,Ca,Ni	Ti,Mg	Si,Fe,Al
87-6-41	133.6-135.1 (438.0-443.0)	Cu,Sc	Y,Sr	Mn,V,Ni,Cr	Zr,Ba,Ca	Ti,Mg,Al	Si,Fe
87-6-42	135.1-136.6 (443.0-448.0)	Cu,Sc	Y,Sr	V,Co,Cr	Mn,Zr,Ba,Ca,Ni	Ti,Mg,Al	Si,Fe,Al
87-6-43	136.6-137.6 (448.0-451.0)	Cu,Sc	Y,Ni,Sr	V,Cr	Mn,Zr,Ba,Ca	Ti,Mg	Si,Fe
87-6-44	137.6-138.0 (451.0-452.6)	Be,Sc	Y	Cu,Co,Sr	Mn,Zr,Ba,V,Ni,Cr	Ti,Ca	Si,Fe,Mg,Al
87-6-47	139.2-140.8 (456.5-461.5)	Be,Sc	Y	Cu,Co	Zr,Ba,V,Ni,Cr,Sr	Mn,Ti	Si,Fe,Mg,Al,Ca
87-6-48	141.4-142.1 (463.5-466.0)	Be,Sc	Y	Cu,Co	Zr,Ba,V,Ni,Cr,Sr	Ti	Si,Mn,Fe,Mg,Al,Ca
87-6-49	138.0-139.2 (452.6-456.5)	Be,Sc	Y	Cu,Co	V,Ni,Zr,Cr,Ba,Sr	Mn,Ti	Si,Fe,Mg,Al,Ca,Na
87-6-50	142.1-142.4 (466.0-467.0)	Be,Ag,Sc	Y	Cu,Co,Cr,La,Sr	V,Ni,Zr,Ba	Ti	Si,Mn,Fe,Mg,Al,Ca
87-6-51	80.2- 81.4 (263.0-267.0)	Be,Sc	Y	Cu,Ni,Co,La	Mn,V,Zr,Cr,Ba,Sr	Ca,Ti	Si,Fe,Mg,Al,Na
87-7-01	30.1- 30.5 (98.6-100.0)	Be	Cu,Sr	V,Zr,Ba	Mn,Ca,Ti,Ni,Cr	Fe,Mg,Al	Si
87-7-02	77.5- 78.0 (254.0-255.6)	Be	Y	Cu,Sr	Mn,V,Ba,Ni,Zr,Cr	Mg,Ca,Ti	Si,Fe,Al,Na
87-8-01	83.9- 84.8 (275.0-278.0)			V,Ni,Zr,Cr,Ba,Sr	Mn	Mg,Ca,Al,Ti	Si,Fe
87-8-02	137.9-138.5 (452.0-454.0)			V,Ni,Zr,Cr,Ba	Mn,Sr	Fe,Mg,Ti	Si,Ca,Al,Ni
87-9-01	112.2-113.8 (368.0-373.0)	Be	Cu,Y,Sr	Ba	Mn,V,Ca,Ni,Zr,Cr	Mg,Al,Ti	Si,Fe
87-9-02	113.8-115.3 (373.0-378.0)	Be	Cu,Y,Sr	V,Ba	Mn,Ni,Zr,Cr	Mg,Al,Ca,Ti	Si,Fe

No analyses for K or Li used in buffer. If not listed, not detected; but, if present:

<1%	Na,P
<.1%	W,As,Cd,Ta
<.05%	Zn,U
<.033%	Th,Ce,Tl
<.01%	Sb,Ge,In,Sn,Mo,Nd,Nb,Bi,Pb
<.005%	Ga,La
<.001%	Y,Yb
<.0001%	Ag,Be,Sc

APPENDIX 3.

SEPARATION OF GRAPHITE, BIOTITE AND MICACEOUS MINERALS FROM A NOVA SCOTIA GARNET SCHIST (ANDREWS, 1988)

Energy, Mines and Resources Canada | Énergie, Mines et Ressources Canada

CANMET

Canada Centre for Mineral and Energy Technology | Centre canadien de la technologie des minéraux et de l'énergie

SEPARATION OF GRAPHITE, BIOTITE AND MICACEOUS MINERALS FROM A NOVA SCOTIA GARNET SCHIST

P.R.A. Andrews
Mineral Processing Laboratory

August 1988

Project: 30.21.02
Beneficiation of Industrial Minerals

MINERAL SCIENCES LABORATORIES
DIVISION REPORT MSL 88-100 (IR)

SEPARATION OF GRAPHITE, BIOTITE AND MICACEOUS MINERALS FROM A NOVA SCOTIA GARNET SCHIST

by

P.R.A. Andrews*

ABSTRACT

A preliminary evaluation was conducted to concentrate garnet from a graphitic, micaceous garnet schist from Chegoggin Point, Nova Scotia. Graphite and illite were successfully removed by a combination of scrubbing and washing. The best scrubbing time was determined as 20 min; scrubbing times in excess of 20 min resulted in abraded garnet surfaces.

Gravity concentration employing laboratory shaking tables concentrated garnet in the -840 +420 μm fraction to 70-75% garnet; in the -420 +150 μm fraction to 80-85% garnet and in the -150 μm fraction to 95% garnet. Although garnet was effectively liberated in the -2.4 mm +840 μm fraction, concentration by tabling was not possible due to a combined effect of similarity in shape and specific gravity between garnet and chlorite, which was more critical at coarser sizes than finer sizes.

Garnet in the -840 +420 μm fraction was further concentrated by reverse flotation of chlorite to 85% garnet. Chlorite was floated at pH 8.0, after prior grinding and desliming at 45 μm to remove illite, using a tertiary amine collector Ethomeen T 25. A chlorite product analyzing 70% chlorite was obtained with 384 g/t of collector. At this pH garnet was unresponsive to Ethomeen T 25.

Keywords: garnet, graphite, chlorite, gravity concentration, flotation

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SÉPARATION DU GRAPHITE, DE LA BICTITE ET DES MINÉRAUX MICACÉS D'UN SCHISTE À GRENAT DE LA NOUVELLE-ÉCOSSE

par

P.R.A. Andrews*

RÉSUMÉ

Une première évaluation a été effectuée pour concentrer le grenat provenant d'un schiste à grenat graphiteux et micacé de Chegoggin Point en Nouvelle-Écosse. Le graphite et l'illite ont été séparés avec succès par épuration et lavage combinés. Le meilleur temps pour l'épuration a été déterminé à 20 minutes; des temps d'épuration plus longs ont donné des surfaces abrasées de grenat.

La concentration par gravité au moyen de tables à secousses de laboratoire a donné dans la fraction -840 +420 µm, entre 70 % et 75 % de grenat; dans la fraction -420 +150 µm de 81 % à 85 %, et dans la fraction -150µm, 95 %. Bien que le grenat soit libéré dans la fraction -2,4 mm +840 µm, sa concentration par tables à secousses n'a pas été possible du fait que le grenat et la chlorite étaient de forme et de densité semblables, similitude qui était plus prononcée pour les grains grossiers que pour les grains fins.

On a poussé à 85 % la concentration du grenat présent dans la fraction -840 +420 µm par flottation inverse de la chlorite. La chlorite était séparée par flotation à pH 8, après broyage et déschlammage à 45 µm pour éliminer l'illite, en présence du collecteur Ethomeen T 25, qui est une amine tertiaire. On a obtenu un produit chloriteux renfermant 70 % de chlorite avec 384 g de collecteur par tonne. À ce pH, le grenat était réfractaire à l'Ethomeen T 25.

Mots clés : grenat, graphite, chlorite, concentration par gravité, flottation

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INTRODUCTION

In October 1987, R. MacDonald of the Nova Scotia Department of Mines, Stellerton, Nova Scotia, discussed with the Industrial Minerals Section the possibility of concentrating garnet from a deposit occurring at Chegoggin Point, Nova Scotia. Subsequently, a 20 kg sample of garnet schist was received in November 1987.

The presence of garnetiferous schist at Chegoggin Point has been known for many years. The deposit was originally reported by Faribault (1919) and preliminary concentration tests conducted by Flynn (1923) and again by Cameron (1952). Results of testwork indicated that concentration of garnet using magnetic and gravity concentration techniques was only partially successful. Magnetic separation produced 60% garnet concentrates at sizes below 600 μm; chlorite could not be effectively separated. Similarly, with tabling at sizes below 800 μm no definite division between concentrate, middling and tailing was possible due to the presence of chlorite.

Before 1987 very little commercial interest was shown in the garnet deposits, although the white quartzite, which overlies the garnet schist, was mined by Dominion Steel and Coal Corporation.

GEOLOGY

The strata at Chegoggin Point cuts the coast line obliquely, the regional strike being N35° to 40°E, magnetic, and the dip approximately 80°E. As exposed along the beach, the rocks are highly metamorphosed to various crystalline schists and slates of varying composition, being micaceous, hornblendic, pyritic or garnetiferous. Exposures of relatively pure hornblende were noted and in places the weaker mica schists curve around the hornblende masses. Several quartz veins were noted, which cut the strata at a very low angle. The quartz veins, as exposed, averaged 200 to 250 mm wide, but were discontinuous over short distances.

Various beds were identified; some appeared to be predominately mica schists containing a few small garnets, while other schists were rich in garnets, the estimated bed thickness being approximately 3 m.

SAMPLE DESCRIPTION

Approximately 20 kg of a garnetiferous graphite micaceous schist, consisting of several large 200 mm ore specimens were received at the Industrial Minerals Laboratory in November 1987. The garnet crystals were subhedral to euhedral in shape ranging in size from 1 mm to 6 mm; the majority being 3 to 4 mm in size, and the entire mineral surfaces were coated with a film of graphite. Other impurities included minor amounts of quartz, and some iron staining on the micaceous minerals which indicated the presence of non-sulphides. The garnet content was estimated to be 50-60% and garnet grains appeared to have a hackly-chisel fracture when crushed with no visible magnetite inclusions.

PROCESSING

Size Reduction

The 20 kg sample was crushed to pass 6 mm and examined visually to assess coarse liberation of garnet. Since there was virtually no coarse liberation, size reduction was continued to 2.4 mm.

Head Sample

A representative 200 g head sample was screened from 2.4 mm to 150 µm and each fraction examined by binocular microscopy to determine mineral content and degree of liberation with decreasing size; results are reported in Table 1.

Secondary Crushing and Sizing

The remainder of the 20 kg sample was further size reduced by roll crushing to pass 840 µm, the garnet liberation size, and sized at -840 +420 µm, -420 +150 µm and -150 µm.

Scrubbing

Visual examination of the three size fractions suggested that processing of the intermediate -420 +150 µm fraction would benefit from a preliminary attrition scrubbing to remove graphitic and chloritic slime. A

1 kg portion was scrubbed at 85% solids in a laboratory Wemco attrition scrubber for 30 min and wet screened at 150 μm to remove slime-forming minerals. Visual assessment indicated that the garnet surfaces were free of graphite, but the surfaces had become abraded and rounded by attrition.

Three scrubbing tests were conducted for 10 min, 20 min and 30 min scrubbing times to determine the optimum time which would least abrade garnet surfaces, but still be sufficient to liberate graphite and micaceous mineral slimes. Visual assessment indicated that scrubbing time should not exceed 20 min.

Gravity Concentration

Portions of -2.4 mm +840 μm, -840 +420 μm and -420 +150 μm size fractions were passed over a Wilfley shaking table, and the -150 μm fraction over a Wilfley slime table to ascertain how efficiently garnet would be concentrated by gravity concentration techniques. The -420 +150 μm fraction was the only size fraction that was scrubbed prior to tabling to remove graphite and micaceous mineral slimes. Visual observations of all products from tabling are reported in Table 2. Product balances for the -420 +150 μm and -150 μm fraction tests, based on X-ray diffraction data, are reported in Table 3.

Graphite Flotation

It was observed during scrubbing tests that liberated graphite formed a film on the surface of the attrition-product mix. A 1 kg sample of -420 +150 μm material was scrubbed for 20 min with NaOH, fuel oil and MIBC (methyl iso-butyl carbinol) frother. After scrubbing a standard graphite float was conducted in a laboratory Denver flotation cell and the graphite concentrate analyzed for carbon.

Micaceous Minerals Flotation

The products from the -840 +420 μm gravity concentration test were re-combined and crushed to pass 600 μm, and riffled into 500 g lots for flotation. Each 500 g lot was wet-ground at 50% solids in a porcelain jar mill with burundum grinding media, and transferred to the laboratory Denver flotation cell. Flotation of micaceous minerals from garnet was conducted

using two flotation procedures. A primary amine, Armac T, tallow amine acetate was employed at pH 8, and a tertiary amine, Ethomeen T 25, polyoxyethylene tallow amine between pH 7.0 and 9.4. Selected micaceous products and garnet concentrates were examined by binocular microscope and analyzed by X-ray diffraction. Flotation testwork product balances are reported in Table 4, and flotation parameter and reagent concentration data in Table 5.

Analysis

X-ray diffraction analysis is a semi-quantitative technique and accuracy is interpreted as ±10%, although analyses are reported to the nearest 5%.

RESULTS

Although garnet was approximately 90% liberated from chlorite and graphite in the -2.4 mm +840 μm fraction, a separation, using a laboratory shaking table was not possible due to a combined effect of similarity in shape and specific gravity between garnet and chlorite, which was more critical at coarser sizes than finer sizes. Better separation between garnet and chlorite might be obtained by jigging at this coarse size. Concentration of garnet improved with decreasing size fractions from 70-75% garnet at -840 +420 μm; 80 to 85% garnet at -420 +150 μm and 95% garnet at -150 μm. Although the principal gangue minerals were chlorite and graphite, the presence of illite in the -150 μm was a major contaminant mineral in this fraction.

The results of a preliminary graphite flotation test indicated that a rougher concentrate analyzing 7.5% C could be obtained. Cleaning would undoubtedly increase the carbon content but this was not attempted.

Further concentration of garnet in the -840 +420 μm fraction was attempted by flotation. Flotation of garnet using the primary amine collector, Armac T, (Test 1) did not significantly increase the grade of garnet concentrate. Better results were obtained with reverse flotation of chlorite using the tertiary amine collector Ethomeen T 25. In Test 2, after grinding, a desliming stage at 25 μm removed 30.6% of the illite for a loss

of only 6.9% of the garnet. Flotation removed 32.2% of the chlorite, so that while 92.1% of the garnet was recovered, the concentrate (rougher tails product) was only upgraded to 80%. In Test 3, the desliming size was increased to 45 μm at which size 24.4% of the illite and 42.0% of the chlorite were removed. The increase in the rejection of chlorite indicates that chlorite particles are coarser than 25 μm. Flotation rejected a further 36.6% of the chlorite so that the garnet concentrate (rougher tails product) was increased to 85% garnet. The recovery at 85.3% was less than in Test 1 due to the greater loss of garnet, 14.1%, in the slime fraction. In Test 4, the desliming size was further increased to 70 μm to ascertain whether greater weight rejection of slime material would improve flotation. At 70 μm the rejection of chlorite increased to 59.9%, the illite rejection was approximately the same as in Tests 1 and 2, at 31.9%; garnet loss increased to 17.0%. Flotation rejected a further 25.1% chlorite but the grade of garnet concentrate was not increased above that obtained in Test 3. In Test 5, the grind time was increased in an attempt to ascertain whether a finer grind would liberate more gangue and improve the selectivity of the garnet concentrate. The results show that while a 90% garnet concentrate (rougher tails product) was obtained, the recovery was reduced to 51%. The principal reason for the reduced recovery being the loss of 37.1% of the garnet in the initial desliming stage.

PHYSICO-CHEMICAL CONSIDERATIONS

Surface Charge

The zero point of charge of garnet has been variously determined between 4.4 (Cases, 1970) and 5.8 (Fuerstenau & Fuerstenau, 1983). Garnet belongs to the orthosilicate crystal group and is characterized by non-sharing of oxygen atoms within the SiO_4 structural unit. This structure on fracturing produces a polar surface and exposed Fe^{3+} and Al^{3+} become hydrolized; as such H^+ and OH^- would be expected to be potential determining ions. Indirect evidence that Fe^{3+} and Al^{3+} can affect the z.p.c. was demonstrated by comparing the flotation behavicur of acid-treated garnet with untreated garnet; acid-treatment reduces the flotation response.

The zero point of charge of chlorite has not been determined; the z.p.c. of a similar sheet silicate mineral, biotite, is 0.4 (Fuerstenau & Fuerstenau, 1983). The z.p.c. of chlorite would be expected to be similar, but variability is suspected due to the presence of Fe^{3+}, Al^{3+} and Mg^{2+} as replacement cations in the mineral lattice. Abramov, 1965 has made an extensive study of the surface properties of chlorite and concluded that the surface consists both of partly hydrophobic and hydrated portions. The existence of weakly acidic Si-OH and amphoteric Al-OH layers are thought to influence floatability.

Adsorption Mechanisms

Garnet responds to anionic and cationic flotation. When employing oleic acid, evidence of chemisorption and electrostatic adsorption from infra-red spectroscopy studies was demonstrated by Pol'kin, Kolmogorova and Solo'ev, 1971. The garnet spectra showed bands for Fe and Al oleates in addition to bands characteristic of the undissociated acid. Adsorption of dodecylamine by electrokinetic potential measurements indicated chemical adsorption of amine ions on the garnet surface and physical adsorption of undissociated amine molecules in the diffused portion of the electrical double layer (Naifonov, 1967).

Chlorite responds to anionic and cationic flotation; in fact chlorite displays the largest flotation area of the sheet-silicate minerals. Manser, 1975 found that there was no lower pH limit with either oleic acid or dodecylamine and only the anionic collector displayed an upper pH limit of between pH 8 and 10. There is an absence of fundamental adsorption data for chlorite but such positive response to flotation would imply both chemisorption and electrostatic adsorption.

Garnet-Chlorite Separation

The flotation of chlorite at pH 8 using the tertiary amine collector Ethomeen T 25 is most likely to occur in an area of negative surface potential and would indicate electrostatic adsorption. Proof of electrostatic adsorption would be demonstrated by non-flotation at pH values below the z.p.c. when chlorite would be positively charged. At pH 8 garnet is unresponsive to Ethomeen T 25.

CONCLUSIONS

Scrubbing effectively removed graphite from garnet surfaces; washing and desliming removed both graphite and illite. Gravity concentration using laboratory shaking tables concentrated garnet in the -840 +420 μm fraction from 70-75% garnet; in the -420 +150 μm fraction from 80-85% garnet and in the -150 μm fraction to 95% garnet. Although garnet was effectively liberated in the -2.4 mm +840 μm fraction, concentration by laboratory shaking table was not possible due to a combined effect of similarity in shape and specific gravity between garnet and chlorite, which was more critical at coarser sizes than finer sizes. By grinding the -840 +420 μm fraction, flotation further improved the garnet concentration from 70 to 75% garnet, to 85% garnet. Further increase in grade to 90% garnet was possible but only with a reduced recovery.

RECOMMENDATIONS

Further testwork at the laboratory and possibly pilot-plant level should be conducted with a larger sample to establish a more selective beneficiation procedure. If garnet from Chegoggin Point can be beneficiated to the extent required for its various uses then the following recommendations would apply:

1. A market study should be conducted to establish size and variety of markets, competition from substitute materials and product evaluation with specifications for the requirements pertaining to the type and acceptable level of deleterious material.

2. Cost benefit analysis should be conducted to establish cut-off grade.

3. Additional diamond drilling should be undertaken to determine ore grade and extent of the deposit.

ACKNOWLEDGEMENTS

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Table 1. Mineralogy of sized fractions

Size fraction µm		Description
	+9.5 mm	Aggregates of euhedral garnet crystals are locked in a chlorite-biotite-graphitic schist; minor quartz present, minor limonitic staining. Graphite coats the unfractured garnet surfaces.
-9.5	+6.7 mm	Similar to +9.5 mm fraction.
-6.7	+3.4 mm	50 to 60% of this fraction euhedral garnet with the crystal surfaces coated with graphite; liberation of garnet from matrix complete.
-3.4	+2.4 mm	Similar to -6.7 +3.4 mm fraction; combined -6.7 +2.4 mm fraction accounts for most of the garnet.
-2.4	+1.2 mm	Garnet crystals are beginning to be fractured; graphite surface coating is still present.
-1.2 mm	+600 µm	Similar to -2.4 + 1.2 mm fraction.
-600	+300 µm	Garnet grains are free of graphite coating; only 15 to 20% of this fraction is garnet.
-300	+150 µm	Garnet grains are clean but only 20 to 30% of the fraction is garnet; biotite/chlorite well delaminated.
	-150 µm	Garnet accounts for 15% and quartz 10% of this fraction; majority is biotite/chlorite.

Table 2. Shaking table gravity concentration testwork

Size fraction	Remarks
-2.4 mm +840 μm	Although garnet was approximately 90% liberated from chlorite and graphite, some garnet faces were still coated by graphite. No visible concentration was observed.
-840 +420 μm	Concentration was estimated at 70 to 75% garnet. The garnet faces were clean and angular displaying the chisel fracture. Garnet content in the tails was estimated to be 5%.
-420 +150 μm	The concentrate and middlings fractions were estimated to contain 80 to 85% garnet. The garnet faces were extremely clean with good angularity. Minor contaminant minerals included quartz with magnetite inclusions, and chlorite. The tails were mainly chlorite with minor garnet and illite. This fraction was the only fraction that was scrubbed to remove illite prior to tabling.
-150 μm	Concentration was estimated at 95% garnet.

Table 3. Product balances for selected gravity concentration testwork

Products	Weight %	Analysis %				Distribution %			
		Garnet	Quartz	Chlorite	Illite	Garnet	Quartz	Chlorite	Illite
-420 +150 µm									
Concentrate	47.3	78	14	8	-	64.9	80.2	13.0	-
Middling	20.5	85	8	7	-	30.6	19.8	4.9	-
Concn + Midd.	67.8	80	12	8	-	95.5	100.0	17.9	-
Tailings	32.2	8	-	74	19	4.5	-	82.1	100.0
Calculated head	100.0	57	8	29	6	100.0	100.0	100.0	100.0
-150 µm									
Concentrate	36.3	96	-	4	-	63.9	-	6.3	-
Middling	27.4	56	-	27	17	28.1	-	31.9	45.9
Tailings 1	36.3	12	-	40	31	8.0	-	61.8	54.1
Calculated head	100.0	55	-	23	22	100.0	-	100.0	100.0

Table 4. Flotation testwork product balances

Test No.	Products	Weight %	Analysis %			Distribution %		
			Garnet	Chlorite	Illite	Garnet	Chlorite	Illite
1	Rougher float	84.0	70	15	15	-	-	-
	Rougher tails	16.0	-	-	-	-	-	-
	Calculated head	100.0	-	-	-	-	-	-
2	Slime	8.4	60	35	5	6.9	17.5	30.6
	Rougher float	7.2	10	75	15	1.0	32.2	7.9
	Rougher tails	84.4	80	10	10	92.1	50.3	61.5
	Calculated head	100.0	73	17	14	100.0	100.0	100.0
3	Slime	20.0	50	35	15	14.1	42.0	24.4
	Rougher float	8.7	5	70	25	0.6	36.6	17.7
	Rougher tails	71.3	85	5	10	85.3	21.4	57.9
	Calculated head	100.0	71	17	12	100.0	100.0	100.0
4	Slime	28.0	40	45	15	17.0	59.9	31.9
	Rougher float	8.8	10	60	30	1.6	25.1	20.1
	Rougher tails	63.2	85	5	10	81.4	15.0	48.0
	Calculated head	100.0	66	21	13	100.0	100.0	100.0
5	Slime	43.5	60	25	15	37.1	63.8	64.0
	Rougher float	16.7	50	25	25	11.9	24.5	16.5
	Rougher tails	39.8	90	5	5	51.0	11.7	19.5
	Calculated head	100.0	70	17	10	100.0	100.0	100.0

Table 5. Flotation parameter and reagent concentration data

Test No.	Flotation stage	No. of stages	Grind time min	Deslime size μm	Float time min	pH	Collectors		Frother
							Arm. T g/t	Eth T 25 g/t	M.I.B.C. g/t
1	Rougher	3	10	-	8.5	8.2	782.7	-	75.1
2	Rougher	2	10	-25	5	9.5	-	557.4	80.3
3	Rougher	2	10	-45	5.5	8.0	-	384.3	46.1
4	Rougher	4	10	-70	11.5	8.2	-	862.6	135.9
5	Rougher	4	20	-70	11.5	8.3	-	1453.0	171.7

APPENDIX 4.

NOVA SCOTIA DEPARTMENT OF MINES, DIAMOND-DRILL HOLE DESCRIPTIONS 1-9 (JONES, 1963)

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property: Lake George Area, Yarmouth County
Hole Number: NSDM-63-1
Elevation:
Ultimate Depth: 81.7 m (268 ft)
Proposed Depth: 182.9 m (600 ft)

Section: 0-81.7 m (0-268 ft)
Azimuth: 312°
Dip: 45°
Started: August 5, 1963
Completed: August 16, 1963

Depth in metres (feet)	Formation
0.0-37.5 (0-123)	Metamorphosed Ordovician-Silurian volcanics: garnet-hornblende gneiss and schist, chlorite schist, greenstone.
37.5 (123)	Sharp conformable contact.
37.5-42.9 (123-140.5)	Black banded white quartzite. Contains much carbonate, sericite, pyrite, and some pyrrhotite along bedding planes.
42.9-43.3 (140.5-142)	Silver-grey sericite schist zone.
43.3-45.4 (142-149)	Banded quartzite as 123-140.5 ft.
45.4-46.4 (149-152)	Silver-grey sericite schist zone with pyrite.
46.4-54.3 (152-178)	Banded quartzite as 123-140.5 ft.
54.3 (178)	Sharp conformable contact.
54.3-56.3 (178-184.5)	Halifax Formation: Chlorite-hornblende gneiss and schist.
56.3-61.0 (184.5-200)	Black slate with much pyrite and pyrrhotite along bedding planes.
61.0-76.3 (200-250)	Silver-grey andalusite-staurolite schist with pyrite.
76.3-76.9 (250-252)	Quartz vein along bedding.
76.9-81.7 (252-268)	Dirty black and grey quartzite with much sericite, small quartz veins. Interbedded silver-grey sericite schist and garnet hornblende schist.
	End hole.

Drilling Performed by: Nova Scotia Department of Mines

Geologist: Barry Jones

ASSAY VALUES: (Nova Scotia Technical College, Science Service, October 30, 1963)

Sample Number	Width of Sample metres (feet)	SiO_2 %	Fe %
1	37.5-39.7 (123-130)	95.11	1.60
2	39.7-42.7 (130-140)	92.34	1.80
3	42.7-45.8 (140-150)	84.07	3.59
4	45.8-48.8 (150-160)	92.41	1.72
5	48.8-51.9 (160-170)	98.23	1.26
6	51.9-54.3 (170-178)	97.48	1.23

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property: Lake George area, Yarmouth County
Hole Number: NSDM-63-2
Elevation: 22.86 m (75 ft) ASL
Ultimate Depth: 146.4 m (480 ft)
Proposed Depth: 182.9 m (600 ft)

Section: 0-84.6 m (0-277.5 ft)
Azimuth: 312°
Dip: 45°
Started: August 19, 1963
Completed: September 6, 1963

Depth in metres (feet)	Formation
0.0-63.9 (0-209.5)	Silurian-Ordovician volcanics. Greenstone, silver-grey mica-schist. Some quartz veins, hornblende-plagioclase gneiss, hornblende-garnet gneiss.
	White Rock Formation
63.9-64.4 (209.5-211.0)	Quartz-mica schist. Probably altered clayey sandstone. Contains pyrite and pyrrhotite.
64.4-64.5 (211.0-211.5)	Silky green chlorite schist with pyrite.
64.5-65.0 (211.5-213.0)	Black-grey quartzite with mica along bedding planes.
65.0-65.6 (213.0-215.0)	Quartz vein along bedding.
65.6-71.7 (215.0-235.0)	Black quartzite with much mica. Minor shearing along bedding planes.
71.7-73.4 (235.0-240.5)	Compact green-grey mica schist.
73.4-73.5 (240.5-241.0)	Light grey to white quartzite.
73.5-73.7 (241.0-241.5)	Grey mica schist.
73.7-73.8 (241.5-242.0)	Greenish garnets-hornblende schist and gneiss.
73.8-74.1 (242.0-243.0)	Quartz vein.
74.1-74.3 (243.0-243.5)	Sheared chlorite-mica schist.
74.3-74.4 (243.5-244.0)	White and grey-white quartzite.
74.4-74.6 (244.0-244.5)	Garnet-hornblende gneiss.
74.6-79.3 (244.5-260.0)	Siliceous mica-schist with sulphides and quartz veins.
79.3-79.6 (260.0-261.0)	Grey quartzite containing much sericite and carbonate.
79.6-80.8 (261.0-265.0)	Grey-white quartzite.
80.8-81.7 (265.0-268.0)	Quartz vein.
81.7-82.5 (268.0-270.5)	Grey-white and white quartzite with sericite mica.
82.5-82.7 (270.5-271.0)	Dirty grey quartzite with much sericite along bedding planes.
82.7-84.6 (271.0-277.5)	Quartz vein with included grey quartzite.

84.6-85.1 (277.5-279.0)	Grey quartzite with much mica.
85.1-86.3 (279.0-283.0)	Quartz vein with included grey-white quartzite. Also much pyrite.
86.3-87.2 (283.0-286.0)	Grey-white quartzite with some quartz veins.
87.2-89.5 (286.0-293.5)	Quartz vein with included quartzite. Also much pyrite.
89.5-90.3 (293.5-296.0)	Sheared grey-green chlorite-mica schist.
	Halifax Formation
90.3-92.4 (296.0-303.0)	Black pyrite rich slate showing crinkled bedding.
92.4-94.1 (303.0-308.5)	Lost core.
94.1-97.9 (308.5-321.0)	Black slate with interbedded quartzite containing carbonate, and chlorite schist bands. Shows crinkled bedding.
97.9-99.1 (321.0-325.0)	Siliceous hornblende schist. Green grey and hard.
99.1-99.4 (325.0-326.0)	Lost core.
99.4-100.0 (326.0-328.0)	Hornblende gneiss containing much pyrite.
100.0-101.6 (328.0-333.0)	Grey-white, dirty quartzite. Quartz veins and some sulphides.
101.6-107.1 (333.0-351.0)	Hornblende-garnet gneiss and schist.
107.1-108.9 (351.0-357.0)	Very dirty, grey quartzite.
108.9-146.4 (357.0-480.0)	Grey quartzite, siliceous mica schist, hornblende-garnet gneiss, black slate. Minor shearing along bedding planes.
	End of hole.

Drilling Performed by: Nova Scotia Department of Mines

Geologist: Barry Jones

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property: Lake George area, Yarmouth County
Hole Number: NSDM-63-3
Elevation: 9.14 m (30 ft) ASL
Ultimate Depth: 76.3 m (250 ft)
Proposed Depth: Arbitrary

Section: 0-31.3 m (0-102.5 ft)
Azimuth: 310°
Dip: 45°
Started: September 7, 1963
Completed: September 12, 1963

Depth in metres (feet)	Formation
0.0-12.7 (0.0-41.5)	Overburden.
12.7-15.9 (41.5-52.0)	Halifax Formation Soft, light grey muscovite mica schist. Often containing small andalusite and staurolite crystals. Thin bands of dirty black quartzite and siliceous mica schist.
15.9-16.2 (52.0-53.0)	Lost core.
16.2-18.3 (53.0-60.0)	As 41.5-52.0 ft.
18.3-18.6 (60.0-61.0)	Lost core.
18.6-21.7 (61.0-71.0)	As 41.5-52.0 ft.
21.7-22.3 (71.0-73.0)	Lost core.
22.3-22.6 (73.0-74.0)	As 41.5-52.0 ft.
22.6-22.8 (74.0-74.6)	Garnet gneiss.
22.8-23.5 (74.6-77.0)	As 41.5-52.0 ft.
23.5-23.9 (77.0-78.5)	Lost core.
23.9-25.2 (78.5-82.5)	As 41.5-52.0 ft.
25.2-25.9 (82.5-85.0)	Lost core.
25.9-26.2 (85.0-86.0)	Medium grained hornblende-plagioclase gneiss. Probably a metamorphosed gabbro dyke.
26.2-26.5 (86.0-87.0)	Lost core.
26.5-27.0 (87.0-88.5)	As 41.5-52.0 ft.
27.0-27.1 (88.5-89.0)	Lost core.
27.1-27.5 (89.0-90.0)	As 41.5-52.0 ft.
27.5-28.2 (90.0-92.5)	Lost core.
28.2-30.8 (92.5-101.0)	Soft mica schist as 41.5-52.0 ft.
30.8-31.3 (101.0-102.5)	Lost core.

31.3-31.9 (102.5-104.5)	Compact, grey-green amphibolite schist.
31.9-35.1 (104.5-115.0)	Silver-grey mica schist. Grey quartzite bands and siliceous mica schist. Carbonate along fractures.
35.1-35.8 (115.0-117.5)	Lost core.
35.8-41.9 (117.5-137.5)	As 104.5-115.0 ft.
41.9-42.7 (137.5-140.0)	Lost core.
42.7-54.1 (140.0-177.5)	As 104.5-115.0 ft.
54.1-55.5 (177.5-182.0)	Lost core.
55.5-57.3 (182.0-188.0)	As 104.5-115.0 ft.
57.3-57.6 (188.0-189.0)	Lost core.
57.6-61.0 (189.0-200.0)	As 104.5-115.0 ft.
61.0-61.8 (200.0-202.5)	Lost core.
61.8-62.5 (202.5-205.0)	As 104.5-115.0 ft.
62.5-63.0 (205.0-206.5)	Lost core.
63.0-63.1 (206.5-207.0)	As 104.5-115.0 ft.
63.1-64.7 (207.0-212.0)	Lost core.
64.7-68.8 (212.0-225.5)	As 104.5-115.0 ft.
68.8-69.1 (225.5-226.5)	Lost core.
69.1-69.8 (226.5-229.0)	As 104.5-115.0 ft.
69.8-70.3 (229.0-230.5)	Quartz vein.
70.3-70.5 (230.5-231.0)	Siliceous schist altered to chlorite-talc schist.
70.5-70.6 (231.0-231.5)	Quartz vein.
70.6-72.7 (231.5-238.5)	Grey quartzite and altered mica schist.
72.7-73.2 (238.5-240.0)	Quartz vein.
73.2-76.3 (240.0-250.0)	Grey and grey-green quartzite with interbedded mica schist.
	End of hole.

Drilling Performed by: Nova Scotia Department of Mines

Geologist: Barry Jones

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property: Lake George area, Yarmouth County
Hole Number: NSDM-63-4
Elevation:
Ultimate Depth: 100.8 m (330.4 ft)
Proposed Depth: Arbitrary

Section: 0-100.8 m (0-330.4 ft)
Azimuth: 300°
Dip: 45°
Started: September 13, 1963
Completed: September 30, 1963

Depth in metres (feet)	Formation
0.0-8.8 (0.0-29.0)	Overburden.
8.8-24.7 (29.0-81.0)	Quartzite: buff grey, fine grained, friable and platy, somewhat schistose, mica present on bedded planes. This is a dirty quartzite and resembles a sandstone. Bedding at 41.0 ft 65°. Small specks of pyrite present. Small specks of quartz at 45.6-46.1 ft also small zone of schisted slate with pyrite cubes. Small quartz vein at 71.8-72.6 ft with blebs of pyrite. Minor pyrrhotite and chalcopyrite bedding at 64.0 ft 63°. Lost core: 44-45.4 ft, 47-51.4 ft, 52.9-53.8 ft, 68.8-69.7 ft.
24.7-31.6 (81.0-103.5)	Mica schist: buff grey banded, sandy, fine grained, some slate bands, small speck of pyrite, very soft, bedding 64° at 86.4 ft, possible small crystals spessartite in section. Altered sediment probably sand shale or shaly sandstone.
31.6-31.9 (103.5-104.5)	Hornblende schist: dark grey green, coarse grained in fracture, weathered.
31.9-100.8 (104.5-330.4)	Garnet-mica schist (sericite): some of the lineation may be original bedding or gneissosity. Irregular blebs and lenses of quartz are common ranging from microscopic to several inches wide. Colour of the core is very light, silver grey with schistosity at 30°±. Some sections might more properly be called a phyllite especially toward the bottom of the section. 154.3-155.5 ft: Quartz vein with some interbedding. Some of the quartz is smoky or drusy. 130-137 ft: Lost core. Core broken: 258-259 ft: Hornblende schist, coarse, grey green. Quartz vein: 279.6-280.8 ft, some muscovite, glassy to milky. Section to 305 ft becoming less sandy and more fine, very soft, easily broken, small garnets and micaceous material. This could be in the range of a phyllite. Quartz vein: 314.0-315.0 ft. 305-330 ft: Core badly broken and lost. Lost core: 156.1-157.9 ft, 139.3-140.4 ft, 178.8-179.4 ft, 221.2-223.5 ft, 225.8-226.3 ft, 227.4-227.8 ft, 231.3-232.4 ft, 234.1-236.0 ft, 240.0-241.0 ft, 253.4-254.4 ft, 256.3-257.5 ft, 260.3-261.3 ft, 263.2-264.4 ft, 269.0-270.0 ft, 270.9-273.8 ft, 277.7-278.9 ft, 282.2-283.8 ft, 297.7-299.1 ft, 300.0-301.0 ft, 307.4-311.0 ft, 315.0-320.0 ft. End of hole.

Drilling Performed by: Nova Scotia Department of Mines

Geologist: Barry Jones

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property: Chegoggin, Yarmouth County
Hole Number: NSDM-63-5
Elevation:
Ultimate Depth: 32.5 m (106.7 ft)
Proposed Depth: Arbitrary

Section: 0-32.5 m (0-106.7 ft)
Azimuth: True North
Dip: 45°
Started: October 1, 1963
Completed: October 11, 1963

Depth in metres (feet)	Formation
0.0-11.0 (0-36.0)	Overburden: Sand, clay, boulders.
11.0-12.2 (36.0-40.0)	Mud with some slate or schist material.
12.2-32.5 (40.0-106.7)	Garnetiferous schist: light, medium grey, fine, soft, easily broken, core badly broken and lost in part. Looks like a slate of phyllite, some sandy section, no mineralization. Cleavage 40° to core, small speck and cubes of pyrite and some pyrrhotite. No quartz vein, no continuity, very difficult to log. Lost core: 45.0-46.2 ft, 47.5-54.1 ft, 57.0-61.4 ft, 65-66.4 ft, 67.2-68.7 ft, 70.0-73.8 ft, 75.0-79.5 ft, 80.0-80.7 ft, 81.4-83.3 ft, 85-89.1 ft, 90.0-93.2 ft, 95-97 ft, 100-103.6 ft.
	End of hole.

Drilling Performed by: Nova Scotia Department of Mines

Geologist: Barry Jones

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property: Lake George, Yarmouth County,
Hole Number: NSDM-63-6
Elevation:
Ultimate Depth: 104.2 m (341.5 ft)
Proposed Depth: Arbitrary

Section: 0-53.4 m (0-175 ft)
Azimuth: 110°
Dip: 45°
Started: October 14, 19[illegible]
Completed: November 4, 1[illegible]

Depth in metres (feet)	Formation
0.0-8.2 (0-27.0)	Overburden.
8.2-11.3± (27.0-37.0±)	Mica schist: dark grey, green black, fine textured, soft core broken, fracture 30° to core. This section became more disturbed at ±37.0 ft. Specks of pyrite present, some hornblende present.
11.3±-18.3 (37.0±-60.0)	Hornblende-mica schist: dark green black, coarse. Lathe like crystals hornblende, micaceous material fine, small speck of pyrite, irregular fracture, some sections are more coarse than others, some sections have platy appearance, also mottled green due to hornblende crystals. Some sections soft and more platy.
18.3-21.2 (60.0-69.5)	Micaceous schist: dark grey black, fine, soft, platy, uneven fracture, small speck of pyrite, some minor hornblende, section in part appears as a slate.
21.2-30.5 (69.5-100)	Quartzite: greyish white.
30.5-32.1 (100-105.4)	Quartzite. From 101.3-101.7 ft hornblende schist rock. Contact of quartzite at schist 60° to core axis. From 101.7-105.4 ft white sugary type of quartz.
32.1-32.5 (105.4-106.5)	Lost core.
32.5-38.1 (106.5-125.0)	Quartzite. White, considerably fractured with fractures coated with iron oxide. Fractures 60° and 30° to core axis. Sections tinted greenish in colour due probably to chlorite, tiny veinlets of pyrite following fractures in the quartzite and also as isolated crystals.
38.1-41.9 (125-137.4)	Quartzite. Greenish tint locally, scattered pyrite. From 135.7-136.2 ft three stringers of pyrite, the widest 1/4 in.
41.9-42.0 (137.4-137.8)	Mica schist.
42.0-42.6 (137.8-139.8)	Lost core.
42.6-42.9 (139.8-140.5)	Mica schist. Contact of mica schist and quartzite is 45° to core axis. Several quartz stringers in schist carrying pyrite and pyrrhotite assume the lost core is mica schist. Sharp contact of schist and quartzite.
42.9-45.8 (140.5-150)	Quartzite. Fractured with tiny veinlets of pyrite and isolated patches and crystals. Veinlets of pyrite 45° to core. Fractures 60° to core. Fractures 45° to core.
45.8-53.4 (150-175)	Quartzite, varies from white to greenish white, sugary texture, ~2% sulphides. Occurs in stringers and as isolated crystals. Scattered chlorite throughout the quartz. Fractures 45° to core.

53.4-61.0 (175-200)	Quartzite, similar to above. Prominent set of fractures 55° to core axis. At 184.8 ft bed 1/4 in wide of brownish coloured mixed with the quartz, bed 42° to core. Similar type of bed at 178.7 ft and 52° to core. Other set of fractures 52° to core.
61.0-68.6 (200-225)	Quartzite, similar to above. At 215.4 ft white quartz, specks of sericite mica, chlorite and pyrite.
68.6-76.3 (225-250)	Quartzite, mostly whitish, narrow bands with included mica. Secondary quartz stringers.
76.3-82.8 (250-271.5)	Quartzite, similar to above.
82.8-83.7 (271.5-274.3)	Band of greenish material cut with quartz. Sharp contacts, possibly bed of argillaceous material altered or narrow line flow.
83.7-91.0 (274.3-298.3)	Quartzite, similar to above.
91.0-92.7 (298.3-304)	Silicified argillaceous band.
92.7-99.3 (304-325.6)	Quartzite, similar to above.
99.3-104.2 (325.6-341.5)	Lava, greenish in colour, massive chloritic and slightly schistose, 75% dark chloritic.

Drilling Performed by: Nova Scotia Department of Mines

Geologist: J. D. Wright

ASSAY VALUES:

Sample Number	Width of Sample metres (feet)	SiO_2 %
1	21.4-25.9 (70-85)	92.91
2	25.9-30.5 (85-100)	98.23
3	30.5-35.1 (100-115)	95.21
4	35.1-39.7 (115-130)	98.75
5	39.7-44.2 (130-145)	93.04
6	44.2-48.8 (145-160)	97.46
7	48.8-53.4 (160-175)	96.94
8	53.4-58.0 (175-190)	98.21
9	58.0-62.5 (190-205)	95.93
10	62.5-67.1 (205-220)	97.92
11	67.1-71.7 (220-235)	98.51
12	71.7-76.3 (235-250)	98.91
13	76.3-80.8 (250-265)	98.11
14	80.8-85.4 (265-280)	88.84
15	85.4-90.0 (280-295)	92.67
16	90.0-94.6 (295-310)	85.27
17	94.6-99.1 (310-325)	96.43

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property: Lake George, Yarmouth County
Hole Number: NSDM-63-7
Elevation:
Ultimate Depth: 38.1 m (125 ft)
Proposed Depth: 38.1 m (125 ft)

Section: 0-38.1 m (0-125 ft)
Azimuth: 110°
Dip: 45°
Started:
Completed:

Depth in metres (feet)	Formation
0.0-9.2 (0-30)	Drift.
9.2-15.4 (30-50.4)	Lava, mottled appearance. Dacite made up of hornblende, feldspar, groundmass fine grained, sections of core considerably altered and slightly schistose, texture varies over narrow widths. Lost core: 40-40.8 ft and 43.8-44.7 ft.
15.4-20.1 (50.4-66)	Fine grained, almost black in colour (andesite), slightly schistose. Gradation from coarse to fine grain is fairly sharp. Hornblende needles visible, rock is all massive. Lost core: 62-63 ft.
20.1-23.2 (66-76)	Dacite, medium textured, massive rock, mottled surface, hornblende and feldspar, 80% dark material. Lost core: 70-71.5 ft and 73.7-75 ft.
23.2-24.6 (76-80.8)	Fine grained, light greenish coloured, slightly schistose and altered dark chloritic material forms 80% of rock, groundmass fine (andesite lava).
24.6-29.0 (80.8-95)	Dacite, hornblende chief constituent with some feldspar and mica, rock appears quite highly metamorphosed. Lost core: 83.7-85 ft, 91.8-93.2 ft.
29.0-29.5 (95-96.8)	Top of flow, possible amygdaloidal. Hornblende-biotite-drawn out surrounding the amygdules that all filled with quartz and chlorite material.
29.5-29.8 (96.8-97.8)	Lost core.
29.8-30.1 (97.8-98.8)	Dacite, dark greenish coloured, medium grained. Some drawing out or stretching of the hornblende 3 in, quartz, glassy, unmineralized.
30.1-30.5 (98.8-100)	Lost core.
30.5-32.0 (100-105)	Dacite, light greenish in colour, mottled appearance, slight parallelism of hornblende and mica, moderately altered. Lost core: 103.2-104.1 ft.
32.0-33.6 (105-110)	Dacite, from 108.3-110 ft quartz, drillhole running parallel to the quartz.
33.6-33.9 (110-111.3)	Andesite, finer grained, greenish in colour, 85% terromagnesiam material.
33.9-35.0 (111.3-114.8)	Lost core.
35.0-38.1 (114.8-125)	Andesite, fine grained, dark greenish in colour, slightly schistose, mica and chlorite material.

Drilling Performed by: Nova Scotia Department of Mines

Geologist: J. D. Wright

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property: Lake George, Yarmouth County
Hole Number: NSDM-63-8
Elevation:
Ultimate Depth: 79.3 m (260 ft)
Proposed Depth:

Section: 0-38.1 m (0-125 ft)
Azimuth: 340°
Dip: 45°
Started:
Completed:

Depth in metres (feet)	Formation
0.0-7.6 (0-25)	Drift.
7.6-8.2 (25-26.8)	Fine grained, dark greenish coloured andesitic lava - slightly schistose.
8.2-9.9 (26.8-32.3)	Lost core.
9.9-10.9 (32.3-35.8)	Andesite, lava, amygdaloidal, slightly sheared amygdules filling white, probably feldspar.
10.9-11.7 (35.8-38.3)	Lost core.
11.7-13.7 (38.3-45)	Andesite, narrow amygdaloidal zones. Banding 70° to core axis. Considerable mica, moderately deformed.
13.7-14.6 (45-47.8)	Lost core.
14.6-15.5 (47.8-50.8)	Andesite lava.
15.5-16.2 (50.8-53)	Lost core.
16.2-17.4 (53-57.2)	Andesite, banding 55° to core axis.
17.4-19.2 (57.2-62.9)	Quartz, fine grained sugary type of quartz, white scattered grains of pyrite, in places oxidized along fractures.
19.2-19.7 (62.9-64.7)	Lost core.
19.7-19.8 (64.7-65)	Quartz.
19.8-20.3 (65-66.4)	Lost core.
20.3-20.4 (66.4-66.9)	Quartz, rusty seams, sugary type.
20.4-21.1 (66.9-69.3)	Lost core.
21.1-21.4 (69.3-70)	Quartz, glassy.
21.4-22.9 (70-75)	Fine grained, light greenish coloured chloritic type of lava, probably altered andesite.
22.9-32.8 (75-107.5)	Altered andesite lava, sheared, made up of hornblende chlorite, mica. Schisting 30° to core axis. Medium textured rock. Quartz 94.2-95 ft and 88.4-88.8 ft. This quartz is inclusive and is mixed up with inclusions of wall rock.
32.8-38.1 (107.5-125)	Quartz vein, glassy type of quartz. Numerous inclusions of wall rock caught up in the quartz at contact and for a distance of 2 ft, isolated inclusions of altered lava distributed throughout the quartz.

38.1-38.9 (125-127.4)	Quartz with 50% inclusions of altered lava, contact zone.
38.9-45.8 (127.4-150)	Dacite, medium grained, highly silicified rock, considerable chlorite after hornblende. Areas of the core are coarse grained, other sections are 75% added quartz. More silicification and alteration than at any point in this hole.
45.8-49.4 (150-162)	Dacite, medium grained, slightly recrystallized.
49.4-53.4 (162-175)	Quartz with 30% inclusions of altered lava; inclusive quartz, inclusions are light greenish in colour, specks of pyrrhotite and pyrite from 172-175 ft, 90% quartz, sharp contact with lava.
53.4-55.1 (175-180.5)	Quartz, sugary type, medium grained, 5% inclusions of altered lava, slightly fractured with pyrite in stringers, thread-like specks of carbonate.
55.1-56.7 (180.5-186)	Dacite lava, silicified, chlorite, mica hornblende rock is slightly sheared.
56.7-58.6 (186-192.2)	Quartz vein type vuggy with some pyrite fillings, vugs appear to be formed from backing out of calcite. Some of the quartz is coarse grained, areas with brownish stain.
58.6-59.2 (192.2-194.2)	Lost core.
59.2-62.2 (194.2-204)	Quartz vein type with inclusions of altered wall rock, slightly fractured with some carbonate stringers, 90% quartz, remainder altered lava. Some chlorite giving the quartz a greenish tint.
62.2-63.0 (204-206.4)	Altered dacite lava. Where not silicified the rock is medium grained with fair sized crystals of hornblende.
63.0-63.5 (206.4-208.2)	Lost core.
63.5-64.1 (208.2-210)	Dacite with quartz injected.
64.1-64.4 (210-211)	Lost core.
64.4-67.1 (211-220)	Quartz, sugary type, greenish tint.
67.1-67.4 (220-221)	Lost core.
67.4-67.7 (221-222)	Quartz.
67.7-68.6 (222-225)	Silicified and sheared lava - chlorite and mica. Schistosity 50° to core axis (hornblende gneiss).
68.6-76.3 (225-250)	Chlorite, schist after andesitic lava, greasy feel, slightly amygdaloidal, light greenish in colour, surface has shreds and outlines of hornblende crystals altered to chlorite. Highly altered rock. Schistosity 40° to core.
76.3-79.3 (250-260)	Chlorite schist, in part, with denser bands made up of hornblende - certainly lava rock last 5 ft. 255-260 ft is massive with hornblende crystals.

Drilling Performed by: Nova Scotia Department of Mines **Geologist:** J. D. Wright

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY
DIAMOND DRILL RECORD

Property: Lake George, Yarmouth County
Hole Number: NSDM-63-9
Elevation:
Ultimate Depth: 57.3 m (188 ft)
Proposed Depth:

Section: 0-57.3 m (0-188 ft)
Azimuth: 110°
Dip: 45°
Started:
Completed:

Depth in metres (feet)	Formation
0.0-6.7 (0-22)	Overburden.
6.7-13.7 (22-45)	Quartzite. Fine grained sugary type of quartz, massive, fractures 30° to core axis, also set 40° to core. At 42 ft bedding 50° to core. Very little variation in composition.
13.7-21.4 (45-70)	Quartzite. Similar to above bands, brownish in colour and holding some mica flakes. Fractures with limonite staining, scant pyrite.
21.4-29.0 (70-95)	Quartzite, white to brownish in colour. Bedding 60° to core axis made prominent by brownish colouration limonitic. Considerable variation in the bedding core axis relations 30-70°. Sugary type of quartz, sedimentary in origin, grains both angular and rounded, at 81.3 ft seam of pyrite.
29.0-36.6 (95-120)	Quartzite, white with an occasional brownish coloured band, scant pyrite filling fractures and later than the quartzite.
36.6-44.2 (120-145)	Quartzite, white to pale greenish in colour. Fractures 30° to core axis. Quartz grains rounded, scant pyrite in fractures.
44.2-51.9 (145-170)	Quartzite at 145.3 ft, 4 in of fairly basic lava. Crystals of quartz, feldspar and hornblende visible. Hole abandoned for the day at 170 ft due to heavy snow storm that blocked the highway.
51.9-57.3 (170-188)	Quartzite.

Drilling Performed by: Nova Scotia Department of Mines

Geologist: J. D. Wright

ASSAY VALUES:

Sample Number	Width of Sample metres (feet)	SiO_2 %
105	29.0-30.5 (95-100)	98.74
106	33.6-38.1 (110-125)	98.84
107	38.1-42.7 (125-140)	98.98
109	47.3-51.9 (155-170)	99.13
110	51.9-54.9 (170-180)	98.92
111	54.9-57.3 (180-188)	97.21